Devoted to Civil Engineering and Contracting

November 4, 1920

McGRAW-HILL COMPANY, INC

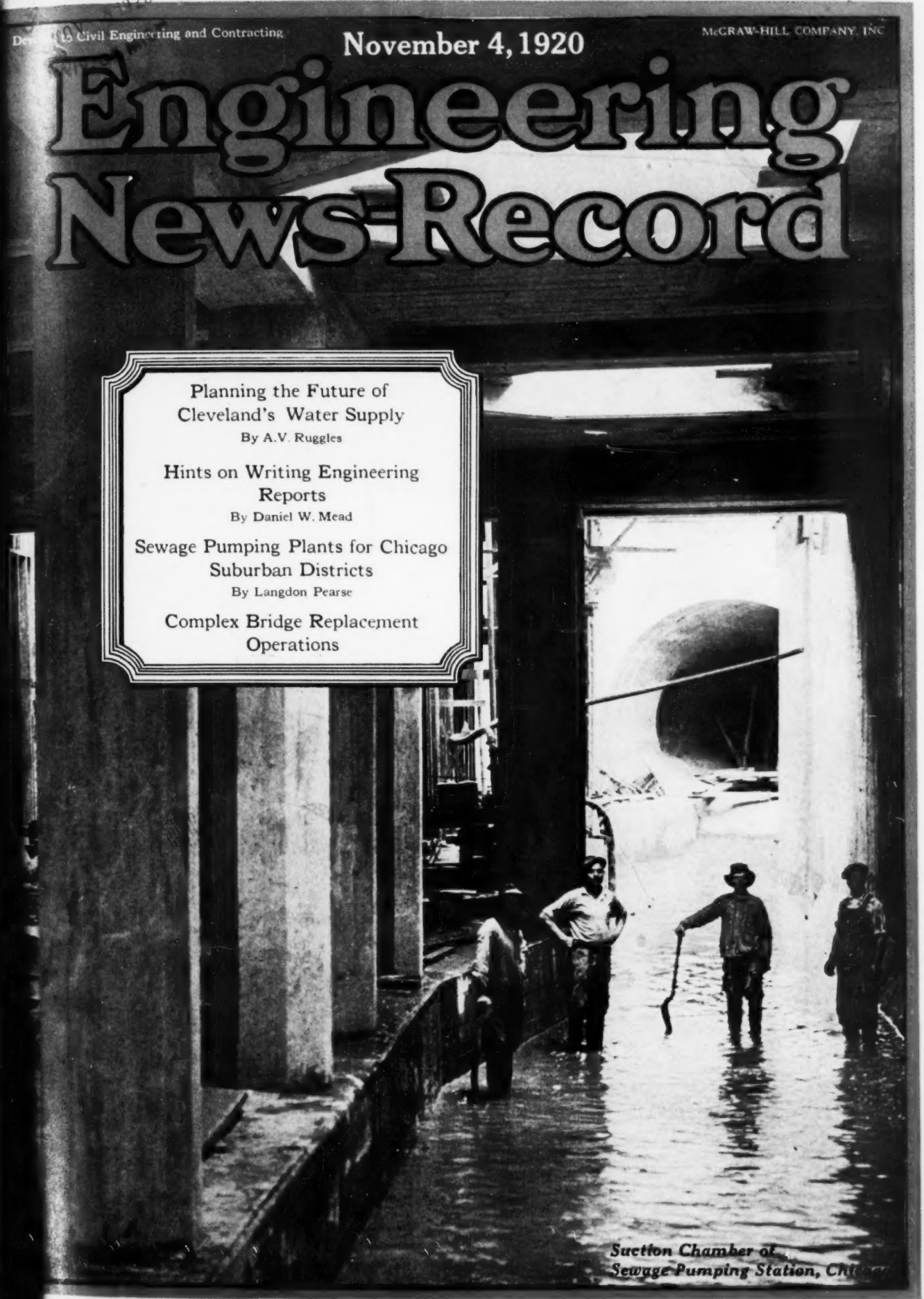
Engineering News-Record

Planning the Future of Cleveland's Water Supply
By A.V. Ruggles

Hints on Writing Engineering Reports
By Daniel W. Mead

Sewage Pumping Plants for Chicago Suburban Districts
By Langdon Pearse

Complex Bridge Replacement Operations



Suction Chamber of Sewage Pumping Station, Chi

Federal Cement Tile Withstands The Acid Test

Detroit Pressed Steel Co.

MANUFACTURERS OF
AUTOMOBILE FRAMES
STEEL STAMPINGS

Detroit

May 15th, 1919.

Federal Cement Tile Company,

Chicago, Illinois.

Gentlemen:

We have, this day, teated two of your Standard Red Pitched tiles which were taken from our Pickling Building, which has been in continuous service. One tile bore the date of May 5th, 1915, and was coated on the underside with asphalt paint. The other was dated August 10th, 1917, which was an addition to the Pickling Building and was not painted on the underside.

The first tile broke under a uniformly distributed load of 3800 pounds and the second one at 3900 pounds. We found the reinforced metal clean and bright in every respect after the tiles were broken into many pieces.

The concrete was also in good condition and we were pleased to learn that the carrying capacity of the slab had increased about seventy percent over tiles 30 days old.

Trusting this will be of service to you, we remain

Yours very truly,

DETROIT PRESSED STEEL CO.

John M. Bischoff

Construction Engineer.

JMB-IT

Another Example of Federal Roof Permanence

Acid fumes in the Pickling Room of the Detroit Pressed Steel Company have eaten their way into the underlying steel work, but the Federal Cement Tile in the roof are stronger than the day they were installed, as stated in the accompanying letter. This is merely an added proof of Federal Indestructibility under unusually severe conditions.

Make your new roof *proof against fire, weather, acid fumes and age.*

"The Indestructible Roof"

FOR FLAT and PITCHED SURFACES

Made, Laid and Guaranteed by

FEDERAL CEMENT TILE COMPANY

110 S. DEARBORN ST.

CHICAGO

HAMMOND, INDIANA. Works DETROIT, MICHIGAN

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

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The Federation's Meeting

WITH the date only two weeks away it becomes more and more apparent that the first meeting of the American Engineering Council will be a very important gathering, even though the civil engineers should refrain from entering the organization. To date (this is written Nov. 1) the names of sixteen member bodies have been announced, including, as the great nucleus, those of the national societies of mechanical, electrical and mining engineers. The membership now represented is 40,000 and the organizing committee expects that when the meeting comes to order Nov. 18 not less than 60,000 engineers will be represented. This is a formidable showing. What action the council takes cannot be a matter of indifference to any engineer. It will stand in the eyes of the public as representative of the engineers of this country. What it does, then, on Nov. 18 and 19, will have the deepest interest.

Water-Supply Needs

INTIMATE studies of water-works consumption and pressure in total and by districts and of corresponding population growths are essential to such forecasts of water-works enlargements as are required from time to time in any growing city. The larger the city and the more diverse its topography and industries, the more complex will be the problem of planning the water-works to meet future needs. Such studies demand a competent permanent engineering staff, some member of which has ample time to devote to the subject. The article on p. 886 details some of the work done at Cleveland, Ohio, in making ready to forecast the water-works needs of that city. The part played by pitometer surveys and by recording pressure gages is worth noting. The need for a reliable population count oftener than the national decennial census is illustrated anew by the various estimates of population to which Mr. Ruggles felt it necessary to resort.

Magnificent Isolation

FREIGHT distribution at New York was commented upon in these columns last week, following a discussion of the subject by the New York Section of the American Society of Civil Engineers. Engineers were in apparent agreement as to fundamentals, but it is indeed unfortunate that a city official should have voiced such antedated opinion as that the City of New York must guard against losing commercial prestige through the establishment, for instance, of classification and unloading points in New Jersey. The possibilities seem great for distribution from New Jersey points in units smaller than the present standard-gage box car. Petty local jealousy cannot stand against public necessity. By the most effective co-ordination of all facilities at the Port of New York, the whole country will benefit, since here is the greatest shipping center. The future of the City of New York is certainly not dependent upon its "magnificent isolation."

That belief in such bald fallacies still exists only indicates the need for combating them with expert engineering opinion through the broadest publicity. So long as such beliefs prevail, conditions at the Port of New York will continue to be bad.

Car-Loading Results

WEEKLY car loadings have passed the million mark and, according to reports made at the meeting of the Association of Railway Executives in New York, Oct. 29, the railroads are carrying a traffic volume heavier even than during the height of the war movement in 1918. T. De Witt Cuyler, chairman of the association said, "The railroads have been confronted with the task of moving this traffic with facilities and equipment admittedly inadequate, but the traffic has been moved. This has been made possible by the hearty co-operation of the shipping public, a very considerable gain in labor efficiency, and an intensive drive by the railroad managers to get the utmost out of existing facilities." In eight months the average car movement per day has increased from 22.3 miles to 27.4 miles, and loading from 28.3 to 29.6 tons. Further co-operative effort by the shipping public will go far toward early attainment of the 30-ton, 30-mile-per-day goal of the railroads.

British Miners' Settlement

SETTLEMENT of the British miners' strike is apparently in sight. The leaders have agreed with the Government on terms, and the ballot on acceptance will probably be canvassed and the results announced before this issue reaches our readers. The full details of the settlement are not clear from reports so far received. The proposal refused by the men before the strike provided that the miners would get an advance of 1 shilling per shift for the maintenance of the rate of production of the first quarter of this year (240,000,000 long tons per annum), and 6 pence per shift for each addition of 4,000,000 tons beyond that figure. Apparently, though, the wages determined in the settlement are to be based not upon the rate of production, but upon the "surplus profits accruing from the export of coal." Not only that, but the mine owners are to be penalized by the loss of a certain percentage of profits if the production falls below predetermined figures—thus making the owners' interest identical with the miners'. Even the introduction in a whole industry of a wage dependent on the yearly production rate would have been a momentous step, but a wage dependent on profits applied to an entire industry, pushes the whole matter of industrial relations forward a tremendous stride. There is such uncertainty in the cabled reports that a final judgment cannot be formed, but the outstanding feature is so clearly a wage variation dependent on profits that the significance of the step deserves to be immediately pointed out. We expect shortly to have in hand the full terms.

Rational Street Planning

OUTSIDE of the more progressive municipal engineering departments few people realize that from 25 to 40 per cent of the area of the built-up portions of our cities is devoted to public streets. These streets have been laid out—one can rarely say planned—to suit the momentary interest or caprice of landowners. And yet when built they become part of the city plan, or lack of plan, to serve as such for decades unless changed, perhaps at great cost. It is one of the functions of the city-planning departments now happily being created all over the country to see that new streets are laid out to meet the needs of the future and of the whole city, instead of to serve the momentary caprice of speculative landowners. Until recently, municipal engineers have done very little to direct public opinion in this respect. The time for alert and intelligent activity on their part has come.

Is It Significant?

HAS the turn come in highway building? The question is prompted by the results of the trial letting by the New York State Highway Commission, Oct. 29. Bids were received on every one of the twelve projects advertised. All the forty-one bids were below the engineer's estimate and though six bids were received on each of two projects, five on three others, etc., there was never a greater variation than 9 per cent between the high and the low bid. There are two features of this experience that warrant attention: first, the number of contractors bidding, and, second, the fact that all bids were below the engineer's estimate. For the first, the explanation evidently is that contractors are finishing their work and want to get ready early for next year's business. The mere submission of bids, however, is gratifying, while the fact that they are below the engineer's estimate is very encouraging. We may safely assume that the engineer's estimate was a reasonable one, since the commission has sources of information regarding prices and conditions and the trends equal to those of the contractors. New York contractors apparently have confidence that the conditions next year are going to be better than those of the immediate past. All indications are that their judgment is a sound one. Transportation is improving steadily, labor is more efficient and not so scarce, price tendencies, generally, are downward. On account of these favorable conditions and the New York experience other States will be encouraged to proceed at once to test conditions by similar lettings.

Business Enterprise

SAMUEL M. VAUCLAIN recently made a remark in addressing some of his fellow-Philadelphians that constitutes a plain challenge to organizations of business men on the score of enterprise, and, though Mr. Vauclain does not go into this phase of the matter, suggests that engineers might profitably think of the same thing. Mr. Vauclain was discussing one of the long-standing problems of Philadelphia, a street bridge across the Delaware, and remarked that in planning large enterprises of the kind nowadays we depend upon the government to build them. In protest against this supine attitude he shot out the pointed question, "Why do not the business men of this city organize a stock company and build a bridge across the Delaware River?" The obvious answer, though Mr. Vauclain did not give it, is that business men's organizations are wanting in enterprise and the vision from which enterprise springs. And a contributory reason is that business men lack contact with engineering thought and opinion.

Until Philadelphia gets the bridge to Camden, the business interests of the city are going to suffer, said Mr. Vauclain. Very true, indeed; and there are many other large communities that are suffering and will suffer similarly from failure to provide adequately for communication, or housing, or other public needs. But the suffering apparently is not sufficiently acute, or the consciousness of the business interests is too callous, for response in the form of action.

Individual business men cannot be charged with unprogressiveness or lack of energy. Business facts speak plainly to them and find response. Perhaps the merchant of our grandfathers' day was more boldly adventurous, but the change is surely not such as to account for the collective lethargy of business men toward public improvements that Mr. Vauclain deplores. Yet any one who has had opportunity to observe the manner in which commercial bodies deal with questions of public improvements will be able to support the implied charge that business men taken collectively do lack enterprise.

Why this is so may be an interesting matter for speculation; but the chief present concern of the case for us is that the engineer's position in the community has a direct relation to the matter. Were business men in the habit of seeking the counsel of engineers where public improvements are at issue, and were they inclined to cultivate contact with them and value their opinions, they would be impelled most strongly toward the solution of large community problems which engineering analysis shows to be necessary and profitable. Lacking such contact and counsel, business men remain alien to these problems until their urgency becomes overwhelming and a hurried emergency solution must be sought.

Considerations of this kind merely add to proof already available that the engineer's efforts to gain larger influence in the community are necessary in the interests of the community itself. They suggest further that where we now fall short is in individual weight of influence, not merely in organized effort. Collective action through federations or associations of engineers is not likely to constitute vitalizing influence on business enterprise of the kind Mr. Vauclain suggested.

Rapid-Transit Station Design

IN THIS issue appears the second and concluding part of Mr. Nilsson's study of rapid-transit station design. It is not so long ago that the problem of urban transportation, especially by subways, was regarded as one applying to only a few of the largest cities in this country and abroad. Today, however, a list of municipalities which have built or are planning to build rapid-transit facilities is lengthy and to it the future will bring many additions. The rapid-transit problem, therefore, has passed from the stage of narrowly restricted interest. For this reason Mr. Nilsson's discussion is both timely and valuable and will appeal to a large group of technical readers who, if they are not immediately concerned in the details of the subject, may soon be called upon to study it.

The basis of rapid-transit station design may be

simply stated as ability to handle passenger-traffic flow without impeding train movements. It is clear, therefore, that the planning of stations, far from being a detached problem in the general transit scheme, is a vital feature in the operation of the lines. The station is not an "auxiliary" structure, but an integral part of the system. Only a few seconds eliminated from the time of loading and unloading passengers at each station means much, in the aggregate, in the headway which it is possible to maintain between trains and, of course, in the total number of train movements. The well-designed station, therefore, exerts a decided influence on the operating finances of the rapid-transit routes. This fact is not always fully appreciated.

Many features of station design are discussed in the article on p. 894, including platform lengths and widths, stairways, and arrangements of exits and entrances. Each case must be governed by local conditions, especially since cities are laid out before rapid transit is proposed. Mr. Nilsson, however, neglects one feature of station layout which is almost universally ignored in this country. We refer to the use of direction signs, maps, and other aids for guiding passengers. People generally lose all sense of direction when they get underground, and, especially at transfer points confusion will be caused unless directions be clearly indicated. In the Paris subways this is done very well. Even the stranger unable to speak French has no occasion to ask his way about in the "Metro."

The engineer's job is not, or should not be, finished when the structure he designs is completed. His is the responsibility of providing something that will operate smoothly and efficiently. This obligation requires not only a knowledge of the strength and disposition of materials in a structure but, in transit design, a study of crowds and how they may be moved quickly and without discomfort.

New York's Building Industry in the Mire

NEW YORK is being treated to a series of disclosures that makes every one allied with construction hang his head, even though he may have no connection with the building industry in New York. It is our industry, and the men, both employers and employees, who are implicated in the scandal are part of the organization by which the work of engineers and architects is consummated. The whole industry suffers when the confidence of the public is shaken.

Unfortunately, too, it is not the first time that the industry has been besmudged by a scandal in building work. Both New York and Chicago have had similar experiences before, while other cities have had "disclosures," if not upheavals. As a rule, though, the scandals touched only one of the large factors; at New York both the employers and the employees are involved. Both had their rings. The plumbing contractors were "advised" on their bids by a lawyer who had all the proposed bids in his hands. The unions paid tribute to a leader whose business was to get their pay increased, and who, at the same time, exacted tribute from contractors in return for his permission to allow them to take contracts and get the necessary labor therefor. Even big contractors—some with national reputations—bowed to the power of the boss, by hiring only such subcontractors had his sanction.

Rumor and the promises of the counsel of the investigating committee, Samuel Untermyer, indicate that the disclosures are not even yet at an end. Mr. Untermyer apparently has a lot of trails, and he is not likely to be thrown off the scent by fear or cajolery. Engineers and contractors, generally, will be glad to see the investigation and the resulting criminal prosecution pushed to the sternest limit, no matter what names go down in the mire. In fact, they are in the mire now—of their own volition—and Mr. Untermyer's job is merely to tear away the curtain that has hitherto hid the situation. What they went into voluntarily, to the detriment of the public, the public should now know.

When the investigating committee was authorized by the New York Legislature the ostensible motive was to discover whether or not there was collusion on the part of manufacturers or dealers in building materials, and whether such collusion, if existing, was interfering with the progress of building construction. So far, it is interesting to note, evidence has not been adduced as to restraining measures on the part of the building-material interests. On the other hand, there has been no statement by the counsel or the committee that evidence of such restraining combination was lacking. For the time being, however, the disclosures relate only to the contractors and to labor.

One properly inquires as to the cause of this sort of a situation. It is, however, so fundamental that any statement of it appears both unnecessary and futile. It is, in brief, due to the low standards which obtain in both the labor and the contracting ends of the building industry. With profit the sole ideal on both sides, all efforts are directed toward squeezing out the greatest net return. Such a thing as creating a great permanent industry has never caught hold in a large way. We like to sneer at anything called medieval, yet in the Middle Ages there was a concept of a building industry devoted to service, in which ideals of craftsmanship pervaded all parties to the organization, and which made for peaceful relations, contented workers, skilled artisans, and left us a heritage in Europe of a group of buildings unsurpassed in architectural beauty—monuments produced by a co-ordinated building industry.

Until some conception of this sort comes, we can expect at fairly regular intervals disclosures of corrupt practices such as are being brought to light at New York. The present scandals will conclude, let us hope, with criminal prosecution. They will be forgotten in a few years and some other crooks will then proceed to do the job over again. It is so much easier, you know, to pay a scoundrel a thousand dollars and be allowed to go ahead with your contract, than go to the trouble, and the very great expense, of putting him out of business. Individuals, of course, cannot accomplish the end alone, except with severe loss. Were the ideals of the industry sufficiently developed, there would be a quick banding together as soon as a scoundrel began operations, and, through private means or the agency of the public's legal machinery, an early end put to his efforts.

Do we hope for any early change of conditions? Emphatically, *no*. We are too prone to follow the easiest way. A quick recovery is impossible. Organization of the building-contracting interests with high-minded leadership—after the manner in which the general contractors have been brought together in the Associated General Contractors—would be a good start. In every group there are strong men who are willing to lead a fight for the right, provided the whole organization is attuned to a high purpose.

Sewage Pumping Plants for Chicago Suburban Districts

Electric Centrifugal Pumps with Diesel Engine Stand-By Service—Large Sluice Gates and Automatic Rack Cleaner

By Langdon Pearse
Sanitary Engineer, Sanitary District of Chicago

THREE electrically-operated sewage pumping stations equipped with centrifugal pumps and having many novel features are under construction by the Sanitary District of Chicago. In the largest of these stations extremely large sluice gates, under a high head of back pressure, control the outlets of the discharge chambers; automatic traveling rakes clean the bar screens; practically the entire basement serves as a suction chamber; some of the larger pumps have motors of different size on each side, and a second source of power from generators driven by Diesel engines is installed for emergency use. In the smaller stations the pumps handle the sewage without the use of screens.

An essential point in the design of all the pumping stations is the provision of large waterways. Electric pumps are run at constant speed, but the variation in sewage flow is compensated by the storage afforded by

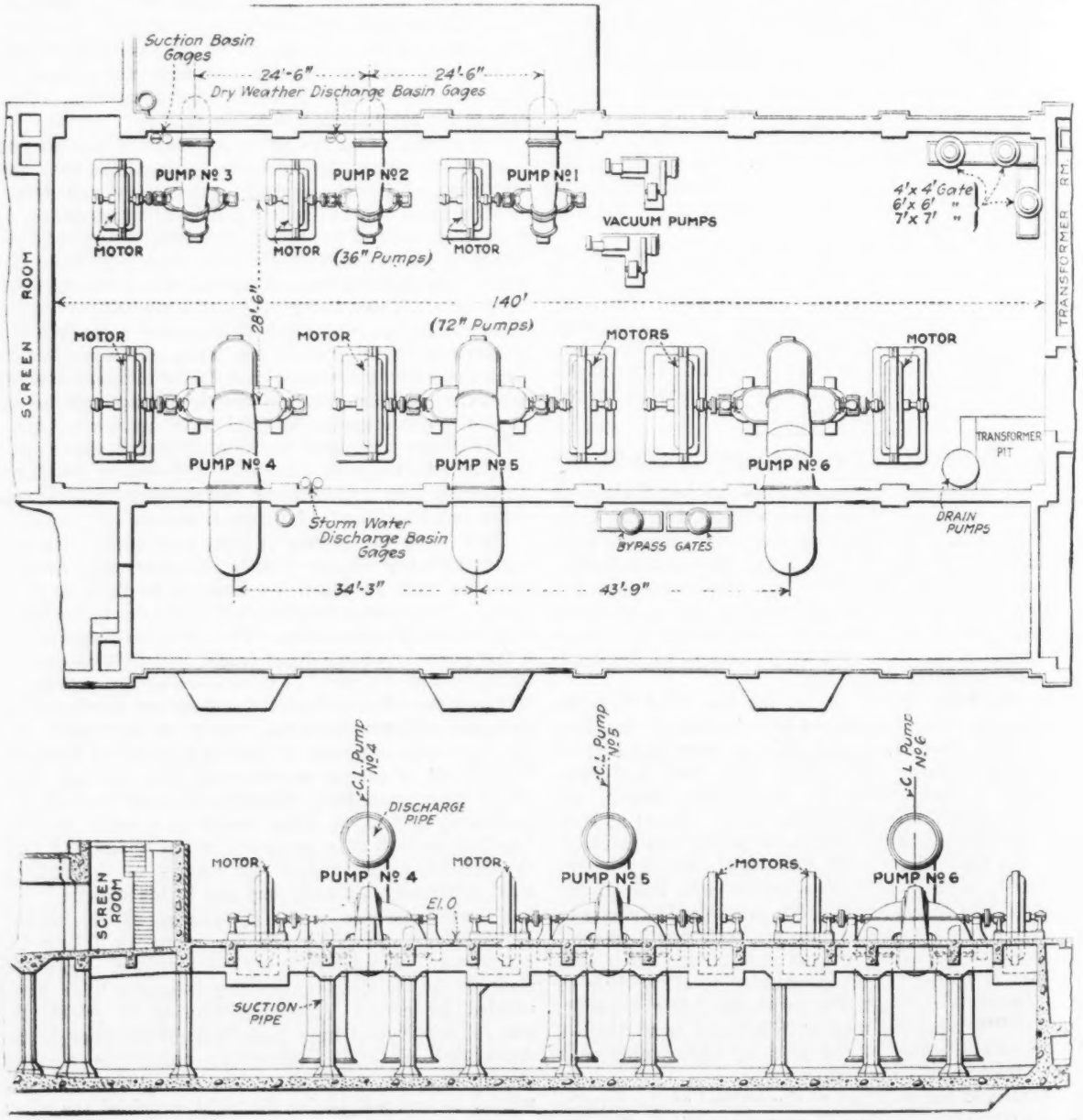


FIG. 1. PLAN AND SECTION OF CALUMET SEWAGE PUMPING STATION

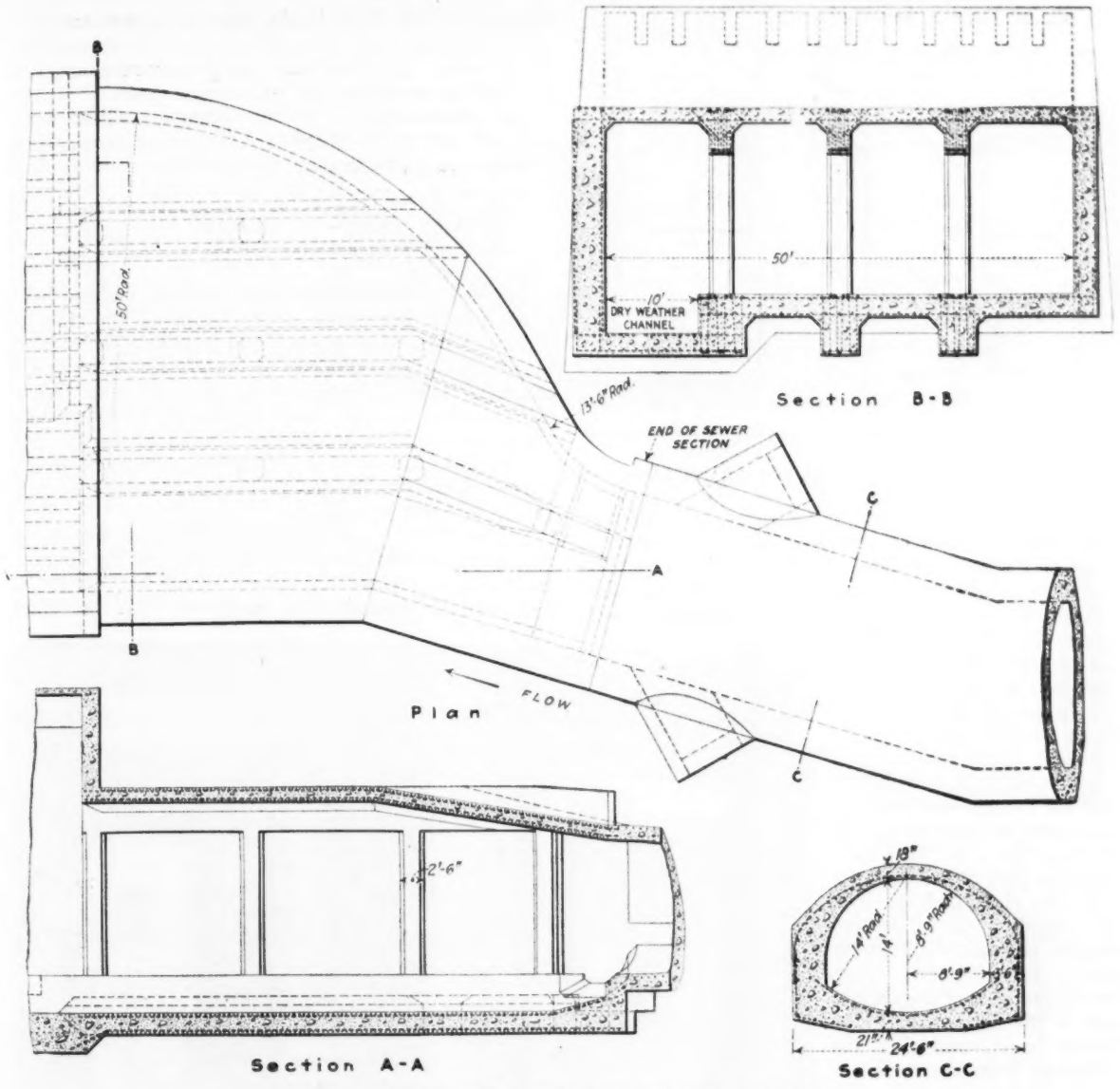


FIG. 2. SEWER CONNECTIONS TO PUMPING STATION

the liberal waterways and by the depth of suction below the flow line. Experience at New Orleans has led to the use of large open basins as far as practicable for both suction and discharge in these stations of the Chicago Sanitary District.

Calumet Pumping Station.—This is the largest plant, including three units handling from 50 to 75 sec.-ft. each and three units handling from 200 to 275 sec.-ft. each. These are all centrifugal pumps with horizontal shafts direct connected to synchronous motors, arranged as shown in Fig. 1. The center of the smaller pumps is set about 18 ft. above low water. The lower ends of the pump suctions and discharge are submerged in the suction and discharge basins, with the highest point of the invert of the discharge above the high water elevation in the discharge basin. This arrangement has the marked advantage of obviating the use of check valves, as large valves of this kind are difficult to design and build. On the smaller pumps, for throttling purposes, gate valves are provided.

At the pumping station, the sewer is of horseshoe shape, 17½ ft. wide by 14 ft. high (see Fig. 2). It drains 12,000 acres, much of which is unimproved low land. The dry weather flow is expected to average from 50 to 75 sec.-ft. with storm flows up to 700 sec.-ft. At the upper end of the sewer, in South Chicago, is the 95th Street sewage pumping station, handling at present a maximum of 250 sec.-ft. During extreme storms, the discharge of this station can be diverted directly to the Calumet River.

Rack Cleaners.—The sewer expands with an easy curve into a screen chamber, 50 ft. wide (see Fig. 2), in which is a rack screen inclined at 37½ deg. to the horizontal, with 4 x ½-in. bars set to give 5 in. in the clear. This screen will be cleaned automatically during storms by a traveling rake (Fig. 3), which moves up the screen and dumps at the platform. The rake remains in a tripped position while lowering, and is rotated at the bottom so that the teeth again enter between the rack bars. The device is counterweighted,

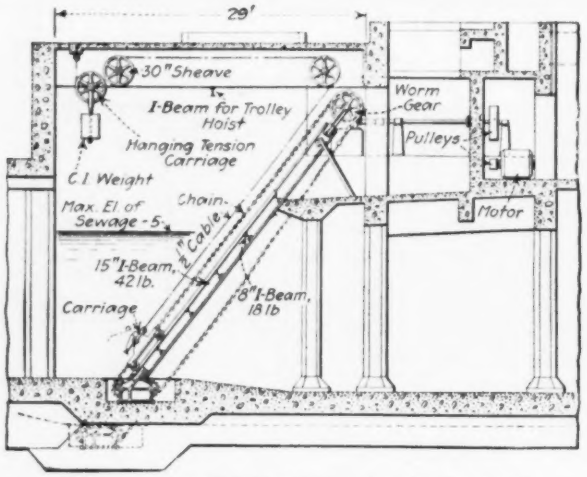


FIG. 3. AUTOMATIC CLEANER FOR TRASH RACK

and will be driven by a reversing motor, with gearing to reduce the speed of rotation. The lineal rate of travel of the rakes is about 35 ft. per minute and the total cycle of cleaning will be about two minutes. Experience at the 39th Street pumping station demonstrates that in dry weather cleaning will be required not more than once a day. The entire basement of the station forms a suction chamber with flat floor. Along the east wall is a channel 10 ft. wide x 3 ft. deep for the dry weather flow. The screen is designed to care for this flow also. In Fig. 4 the main part of the chamber is at the right and the men are standing in the dry-weather channel, with the incoming sewer behind them. On the east side of the suction well is the dry weather discharge basin, receiving the discharge from the three 75-sec.-ft. pumps. On the west side of the suction well lies the storm water discharge basin receiving the discharge from the three 275-sec.-ft. pumps. Ordinarily the latter basin will be kept drained. Each of the two basins is provided with outlet sluice gates so that the discharge may be passed either to the high-level outfall, flowing west to the Calumet-Sag channel behind the controlling works, or south to the low-level emergency outfall direct to the Calumet River. These outlets are shown in Fig. 5. Provision is also made for diverting the dry weather discharge flow to treatment works, plans for which are now being prepared.

The controlling sluice gates include four 96 x 96-in., six 84 x 84-in., one 72 x 72-in. and one 48 x 48-in. gates. They are all hydraulically operated and are designed to stand a backwater pressure of 25 ft. The cylinders are designed to operate normally with a head of 10 ft. on either side of the gate with the city water pressure of 30 lb. per sq. in. in the cylinder. To operate at low city pressure or with high heads, pressure pumps are provided to furnish each gate 150 gal. per minute against 175 ft. head. For emergencies six 2-in. hand pumps are provided for operating the large sluice gates.

The characteristics of the pumps, which were designed by A. B. Wood, consulting engineer, New Orleans, are approximately as follows:

Nominal Size, In.	Normal Capacity, Sec.-ft.	Speed, R.p.m.	Motor, Hp.
36	75	257	106
72	190	106	450
72	275	150	1,100

The motors are of the synchronous type, and are built to start with the pump casings empty. For standby service at time of emergency and to reduce the current required to a minimum, two of the 275-sec.-ft. units are arranged with two motors, one on each side. When delivering to the high level outfall the 1,100-hp. 150-r.p.m. motor will be coupled up. In an emergency this can be discontinued and the 450-hp. 106-r.p.m. motor connected, so that 380 sec. ft. can be pumped with only 900 hp. of current required.

As the Calumet pumping station has to operate at all times to prevent flooding of Pullman and Kensington, two sources of power are to be provided. One is the hydro-electric current from Lockport. For the other installation it is proposed to install in an adjoining building two 500-kw. generators driven by Diesel engines. Oil engines of this type seem admirably fitted for such a stand-by intermittent service. The oil can be stored in underground concrete tanks.

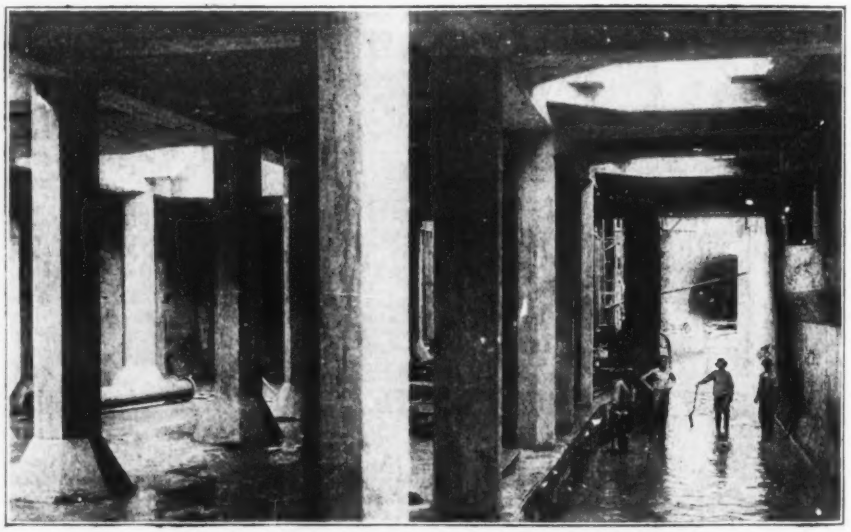


FIG. 4. SUCTION CHAMBER IN BASEMENT

As the pumps will operate normally under 12 to 18-ft. suction lift, priming is secured by a vacuum system. Encircling the pump room is a set of vacuum pipes, to which each pump is connected. At each pump is an automatic vacuum breaker of special design to break the vacuum on the pump when the current to the motor is cut off for any reason. The vacuum will be secured by two hydro-turbine vacuum pumps, each having a displacement of approximately 450 cu.ft. per minute, and capable of holding a vacuum necessary for a maximum lift of 22 ft. Each pump is operated by silent chain drive from a 25-hp. motor.

The suction and discharge tubes are built up of wrought-iron sheets, riveted up in complete sections for bolting in place. To prevent sweating it is proposed to cover these tubes inside the pump room with a double layer of felt. The foundations and substructure of the building are of reinforced concrete, mostly of a 1:2:4 mix. Where water may stand to a head of 10 to 12 ft. on one side, as in the wall between the pump room and discharge basins, a 1:1½:3 mix was used. In the columns and walls, 5 per cent of hydrated lime was added to the cement. As it is possible that in an emergency the suction level might rise to the elevation of the pump room floor, no openings are left from the pump room to the suction chamber. The only access is through the screen chamber. The basins have been tested and found thoroughly tight.

FIG. 5. CALUMET SEWAGE PUMPING STATION, CHICAGO

The building shown in Fig. 6 has a steel frame, with columns carrying the roof girders and runways for a 20-ton crane. The roof is a 3-in. reinforced concrete slab, covered with 2-in. gypsum blocks for insulation, and a waterproof roofing. For the erection of the machinery a trestle has been built in the building, so that a railroad car can be run directly in and machinery unloaded under cover by the crane. For the Calumet station the T. J. Forschner Contracting Co. is the general contractor.

Evanston Pumping Station.—The Evanston and Des Plaines pumping stations are much smaller than the Calumet station, and differ from it in having submerged vertical shaft pumps. As the two stations are very similar in type, only the Evanston station will be described in detail. It serves about 400 acres of low-level sewered area. The station pumps into a gravity outfall sewer through a normal lift of 10-ft. suction-to-discharge water elevations. The total capacity is 133 sec.-ft. In such a small station, it was thought best to avoid the use of screens. Hence the pumps used are of the Wood trash pump type, having a solid runner through which are two curved passages practically the same size as the suction and discharge openings. This type of pump is used in the hydraulic dredges of the New Orleans Canal, as described in *Engineering News-Record* of July 22, 1920, p. 166.

The general plan comprises a dry pump well of rectangular shape, flanked on one side by the suction chamber and on the other by the discharge, as shown in Fig. 6. At one end is placed an emergency overflow or by-pass; at the other end a coal pocket. The 6-ft. incoming sewer enters a suction chamber, 4 ft. wide, running the entire length of the building. The suctions of the pumps, each equipped with a hand-operated sluice gate, draw from this chamber.

Between the suction and discharge chamber is the pump pit, a dry well, 26½ ft. x 72 ft. in plan, in which are set six motor-driven vertical-shaft centrifugal pumps. Three pumps have a capacity of 35 sec.-ft. each at 200 r.p.m. and are driven by 100-hp. motors. The others have a capacity of 9.6 sec.-ft. each at 257 r.p.m. and are driven by 25-hp. motors. In the suction and discharge line of each pump are hand-operated gate valves and in the discharge is a check valve. To provide for the fluctuation in flow and to operate the pumps continuously, particularly on dry weather flows, a by-pass is provided from the discharge of a small pump to

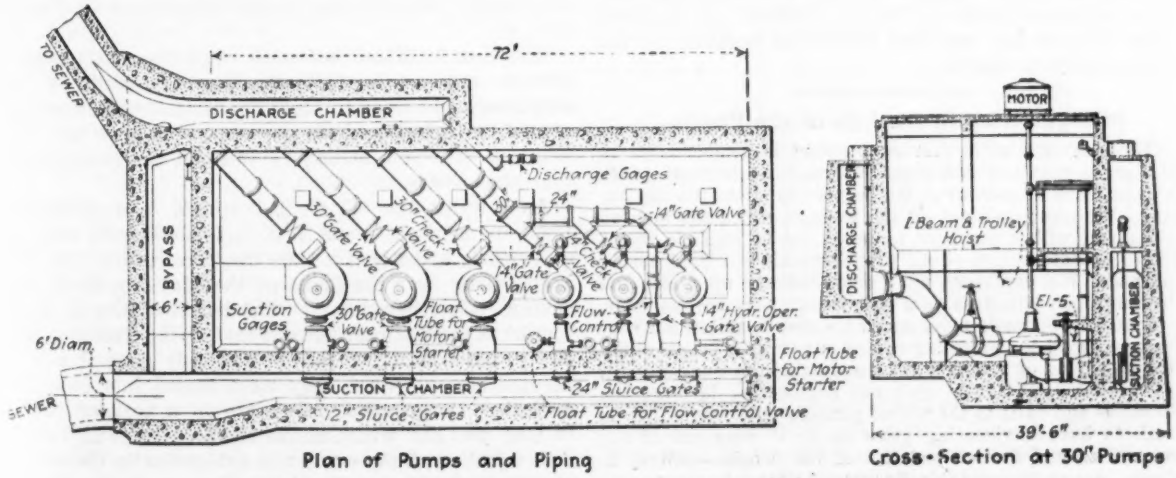


FIG. 6. PLANT ARRANGEMENT AT EVANSTON PUMPING STATION

the suction well, with float control connected to a hydraulic gate valve. This will automatically by-pass sufficient sewage from the discharge end to maintain a fairly uniform elevation in the suction chamber. The motors are arranged to operate automatically by a float switch control.

Owing to the soft and wet nature of the subsoil and foundations, the substructure is reinforced for water pressure on the outside, all over the sides and on the bottom. As the Evanston station is in a residential district, the surrounding land will be grassed and planted with shrubs. For this pumping station, the Nash-Dowdle Co. is the general contractor.

Des Plaines Pumping Station.—This station is located in Broadview, and receives the dry weather flow from a residential district including the villages of Melrose Park, Maywood, River Forest, Forest Park and a part of Oak Park. This sewage from the outlet of the Des Plaines river intercepting sewer is lifted into the sewage treatment plant. Station capacity is provided for three present pumps at 6.5 sec.-ft. each and two future pumps of 20 sec.-ft. each. All of these are of the Wood trash pump type, already mentioned. The nominal head will vary from 25 to 32 ft. total lift. The present pumps discharge into a 24-in. cast iron force main which passes through a Venturi meter to the grit chamber. The future pumps will discharge through a second force main.

The general plan of the station is slightly different from that at Evanston, not only hydraulically, but also because it is combined with the blower house for the sewage treatment works. The 5½-ft. incoming sewer feeds a suction well, tapering in plan, along one side of the basement. One main sluice gate is provided to shut off the entire suction well, instead of individual sluice gates as at Evanston. Each suction is provided with a flange with tapped holes and bronze bolts for securing a blank flange in an emergency. The Leyden-Ortseifen Co. has the general contract.

All these pumping stations have been designed for the Sanitary District of Chicago under the direction of George M. Wisner, chief engineer, until his resignation in May, when E. J. Kelly, then assistant chief engineer, assumed Mr. Wisner's duties. The engineering staff comprises C. R. Dart, bridge engineer; Langdon Pearse, sanitary engineer; F. L. Barrett, architect and H. I. Steffa, mechanical engineer. R. H. Burke, division engineer, is in charge of the construction. A. B. Wood, New Orleans, La., has been consulting engineer on the three pumping plants.

Engineering in the Life of the People

We must see to it that engineering is democratized in the sense that art has been. It must be brought to or within reach or control of the people—to quote the dictionary. We must seek out all the ways in which the man on the street with a thousand interests can be made to feel a sense of satisfaction—even proprietorship—in engineering advance. We, engineers, must avoid building up a cult and looking upon ourselves as a class apart. On the contrary, we must individually more and more seek to widen our contacts with all the pulsating life of our times. Let us study the technique of reaching the people through non-technical publications and throw open our engineering laboratories, libraries and halls to the widest possible public use. Let us seek to have engineering grow up as it were out of the necessities and desires and life of the people.—*Morris L. Cooke, before Philadelphia Engineers' Club.*

Industrial Situation in France

Conditions Improving, but Employers Backward in Labor Policies—Tariff Discrimination Against American Goods

(By an American, resident in Paris)

INDUSTRIAL conditions in France, while still leaving much to be desired, are rapidly improving and, with the exception of Belgium, internal conditions are better than in any of her European neighbors.

During last winter and spring, interested observers were very skeptical of there being a decided increase in French industrial production during 1920. Coal was very scarce, labor uneasy and near-revolutionary in spirit and, worst of all, railway and water transportation were badly demoralized. But we are glad to feel that we were mistaken, for it is believed that from February to October these conditions have improved at least 50 per cent.

The supply of German coal has relieved the lack of fuel enormously and if their shipments continue as during August and September, France can count on 80 per cent of her pre-war requirements for the coming winter. That is sufficient for the time being—sufficient, because her industries have not the labor nor the prime materials with which to work on a 100 per cent basis, nor will they have for a long time to come.

Labor Situation

When one considers that France lost almost two millions of her producing labor during the war—two million young men in the prime of life, who cannot be replaced for at least a generation, if ever—one realizes that it is impossible for her to produce as before the war.

The labor that remains is not more than 75 per cent as efficient and is badly affected by Bolshevist propaganda, although not so badly as in most of the surrounding countries. The solid front displayed by the Government on May 1 last, together with the lack of support from the peasantry and, in many instances, from the union men in the Provinces, put a sad crimp in the extremists and averted a revolution for this year at least. Yet the danger is not completely eliminated, for the successes of the Italian workmen in occupying the metallurgic factories and in forcing the Italian Government and their employers to a compromise which was a virtual victory, has greatly encouraged the French radicals.

This was instanced last week when one of the largest French automobile factories was occupied by the employees, who tried to force the same condition as that obtaining in Italy, where the employees have now just as much (if not a stronger) voice in the management than the owners.

As I write, the "C. G. T.," which, in a syndicalist form, corresponds to our A. F. L., is holding its congress at Orleans, and a warm time they are having, for they are fighting over the fiasco of the May-day Strike and calling each other names. The heads of the C. G. T. fought to their utmost against that strike, realizing that it was foredoomed to failure and only gave it a half-hearted support when they were forced into it by the radicals. Consequently, they are in a position to say "I told you so," which makes the sore-heads still sorer.

But just as all the world was astounded by the sturdy, steadfast resistance offered the German by the French

army during the long war, so are we all gratified by the solidity of the large majority of the working class in France and the lack of progress made by Bolshevist propaganda. For one hot-head who preaches communism there are twenty who reject it.

ATTITUDE OF EMPLOYERS

The worst feature of the situation is that the French employer, as a rule, has no foresight in dealing with his employees. He gives them better wages today simply because he must, but outside his purely business relation with his employee he has no further interest in him as a human being. There are a few, notable exceptions, but this is true as a rule.

The day is close at hand when in all countries the employer must be willing to treat with labor as a partner and to divide his profits with his workmen. He must go further and see that his employees shall have the proper facilities for spending their earnings and for *saving* them as well as look after their physical and moral welfare. To an American reader this may seem axiomatic and hardly worth mentioning, for it is generally accepted in the United States; but we must realize that it is but a recent step even with us and that the European employer has not yet reached this point of view nor will he until he is forced to it as an individual.

For the Frenchman is decidedly individualistic and this individualism is at once the balance wheel of the French industrial machine and an impediment to its advance; for the French are not at all disposed to combine and act in unison for the good of all. No such combined effort as that of the American woman last spring, when they forced a reduction in meat prices by refusing to buy, or of the country as a whole in wearing their old clothes—no such unity of action would obtain in France. If proposed to a Frenchman, he would at once see the logic and agree that it was a mighty good thing to do and that everyone should do it; but to himself and his wife he says, "Let George do it," and goes on in his own individual and selfish way, as his father and father's father did before him.

Something of this same spirit makes the French resent the idea that American engineers or contractors should have any part in the reconstruction program. They invited our engineering societies to come over and advise with them, but I will wager that back in their heads was not so much the thought that they would get sound engineering counsel and advice as that the visit might impress us with the need of financial help and lead to aid from America in that way.

No matter what he may say, the average Frenchman firmly believes that the rest of the world owes France all that she has suffered financially from the war and that the United States, in particular, should pay the greatest part of her loss. And if she is really grateful to the United States for our part in the war, she has a very queer way of showing it. She cannot be blamed for wanting to do her own rebuilding with her own men and in her own way, but before she asks us for help she should put her own house in order: decree and enforce the payment of taxes in such proportion as has Great Britain and the United States.

Moreover, if she wishes us to believe that she appreciates what we have already done, she should put American commerce on a parity with that of the most favored nations. Take up a copy of the French tariff as applied before the war and see on what proportion of the items the American products got the minimum rate. Not 10 per cent. You doubtless think that that has been changed since the war, that Mr. Wilson saw to it that in the future our country would be on a par with Great Britain and Germany. But he did not. France has passed so many decrees affecting the customs since the Armistice that one never knows from today to tomorrow what the duty may be on any given item; but of one thing he may be certain—that goods coming from the United States (prime materials excepted) will pay from 50 to 100 per cent more duty than the same goods from England *or from Germany*.

Take anilines for an example: American anilines are much asked for here, but, whereas the English *or German* dyes pay but 3 francs the kilo, the American goods pay *six* francs. The same thing applies to many other products.

Gratitude? We don't ask that,—but we ask a square deal and we don't get it.

Paris, Oct. 1, 1920.

Lack of Cement Results in New Pavement Base for City of Providence

BECAUSE cement shipments were so uncertain and because the time factor was so important, J. H. Johnson, superintendent of highways, Providence, R. I., decided upon the use of a penetration base upon which to place sheet asphalt on some of the numerous reconstruction jobs being done under his supervision. In several instances where he is using his new "black base" cement concrete had been specified. The result of his experiment, Mr. Johnson believes, will be just as good a street in the least time possible for construction, and at a considerable saving in cost over cement concrete.

The longest job of this character is on Charles St. where approximately a mile of sheet asphalt on a penetration base is being laid. Upon the graded and compacted subgrade are placed 6 in. of 2-in. trap rock, sand-filled and rolled to a compact thickness of 4 in. After being rolled excess sand is swept away and a 2-in. course of 2-in. trap rock is laid and rolled. The whole is then penetrated with asphalt of 95 penetration, 1½ gal. of asphalt to the square yard being used. The surface is then spread with ¾-in. stone. The whole is rolled thoroughly, excess stone then being removed.

The sheet asphalt is laid in two courses. First is laid a binder course of 1½ in., compact thickness, another course being added to bring the topping thickness to 3 in.

The work on Charles St. is made more difficult by the presence of a street railway track through its center. New rails were placed by the railway company when the street work was done, and stone blocks, cement grouted, were laid between rails on an existing cement concrete base.

Mr. Johnson is using the penetration base for the reconstruction of another street where stone blocks are being laid. A sand cushion is spread on the penetration base, the blocks then laid and grouted with cement.

Though Mr. Johnson has not been able to determine how the cost of an asphalt surface on a penetration base will compare with the cost of that laid on a cement concrete foundation, the cost so far for the penetration base has been $1.32 per square yard, a price which includes the preparation of the subgrade after the necessary excavation has been done.

Dam Contract Has Special Cost-Plus Feature

Provision Made for Sliding Scale of Payments Depending on Actual Cost of Wanaque Water Supply Project in New Jersey

PAYMENT on a cost-plus basis, involving a sliding scale depending upon whether the actual cost of construction exceeds or is less than the base price estimated, is the feature of the contract for a portion of the Wanaque earth dam for the North Jersey District Water Supply Commission, bids for which were opened Oct. 28. This feature of the contract was commented upon editorially in this journal, Oct. 21, p. 773.

The work involves the creation of an impounding reservoir of 11,000,000,000 gal. capacity on the Wanaque River. For the earth dam a concrete and puddle core wall, 970 ft. long, will be excavated from the ground surface to bed rock by means of a sheeted trench 100 ft. or more in depth. In the present contract the construction of the concrete and clay puddle core-wall from bed rock to the surface of the ground, excavation of a channel in rock, removal of existing mill buildings, and erection of miscellaneous structures are the main features. The work will require 83,500 cu.yd. of earth excavation, 16,000 cu.yd. of rock excavation, 8,000 cu.yd. of clay puddle 28,500 cu.yd. of concrete, and 1,000 tons of steel sheetpiling.

Alternative forms of contract are offered to contractors, one designated as Proposal A, providing for the cost-plus-a-percentage fee, and the other, Proposal B, being on a straight unit-price basis. The following excerpts from the contract explain the cost-plus feature:

The form of contract under Proposal A provides that the Commission shall pay the actual cost of the work plus a percentage fee. This fee is increased or decreased according as the cost of the work is less or greater than the established price. The work is divided into various items and a price has been set for which it is estimated that unit quantities of the respective items may be constructed or furnished. Most of these so-called base unit prices are estimated upon a definite wage rate for common labor and are subject to adjustment in proportion to any fluctuations which may occur in this common labor base wage rate during the life of the contract

The sum of the base unit prices times the estimated approximate quantities for the respective items, gives an estimated price upon which the contractor will bid his percentage compensation fee. The sum of the adjusted base unit prices times the respective quantities actually constructed gives the established base price which is used in connection with the actual cost to determine the compensation fee to be finally paid.

The cost of the work is divided into classes, viz.:

(1) Construction cost to include in general elements over which the contractor has a large measure of control by virtue of his experience, organizing ability, and efficiency, and briefly, comprises expenditures for labor, rental of plant, power, fuel, and the basic materials.

(2) Construction cost to include minor elements or elements the cost of which are largely beyond the control of the contractor, and, briefly, comprises expenditures for freight, traveling expenses for employees, miscellaneous materials, tools and supplies, and buildings.

(3) Construction cost to include expenses entirely within the control of the contractor and, briefly, comprises salary and personal expenses of the contractor, executive officers and officials, and general overhead charges.

The Commission will pay all legitimate charges against the actual construction cost of the work as outlined in (1) and (2), but expenses outlined in (3) will be paid by the contractor out of his fee.

The contractor's compensation fee is also divided into classes, viz.:

(1) The fee bid by the contractor which will be paid at the bid percentage rate against the Class 1 Construction Cost, should the latter be equal to the Base Price, but will be increased or decreased according as the Class 1 Construction Cost be less or more than the Base Price. The contractor's fee will not be reduced below 4 per cent for reason of any such increased cost.

(2) A flat 4 per cent on all expenditures for Class 2 construction cost.

SCHEDULE OF BASE UNIT PRICES

Item No.	Description	Base Unit Price
1	Earth excavation with sloped sides for core-wall (cu.yd.)	$1 10
2	Earth excavation for core-wall trench, above elevation 150 (cu.yd.)	5 75
3	Earth excavation for core-wall trench, below elevation 150 (cu.yd.)	10 00
4	Earth excavation, general (cu.yd.)	2 00
5	Rock excavation by specific methods	8 00
6	Rock excavation, general (cu.yd.)	5 00
7	Special preparation of rock surface (sq.ft.)	10
8	Clay puddle (cu.yd.)	6 00
9	Refill and embankment, impervious earth (cu.yd.)	2 00
10	Refill and embankment, general (cu.yd.)	1 00
11	Cement (bbl.)	2 50
12	Concrete (cu.yd.)	7 50
13	Paving (cu.yd.)	6 00
14	Grout (cu.yd.)	20 00
15	Drilling small holes in rock or masonry (lin. ft.)	50
16	Furnishing steel sheet piling (ton)	85 00
17	Driving steel sheet piling (sq.ft.)	60
18	Vitrified pipe (lin.ft.)	50
19	Furnishing timber and lumber (M ft.b.m.)	50 00
20	Placing timber and lumber (M ft.b.m.)	50 00
21	Guard rail (lin.ft.)	50
22	Gravel road surfacing (cu.yd.)	3 00
23	Fence, lin.ft.)	50
24	Pumping (mil ft gal.)	80
25	Moving buildings (lump sum)	3,000 00
26	Water supply and sewerage for Commission's buildings (lump)	2,500 00

It is agreed that the estimated unit prices given [in the table] are based on labor conditions and market prices at the mill for cement, steel sheet piling and lumber 30 days prior to the date of the advertisement of this contract and on a wage rate for common labor of fifty-seven (57) cents per hour, the rate being paid on that date for the best grade of common labor on trench work by the Bureau of Water, Department of Streets and Public Improvements of the City of Newark, N. J., and that they are subject to adjustment as provided [later].

(2) The sum of the amounts obtained by multiplying each item quantity in the final estimate by the corresponding base unit price as named in the schedule or adjusted base unit price established as herein provided will be termed the base price.

(3) Should the actual Class 1 construction cost be equal to the base price, the Class 1 compensation fee shall be the percentage of such construction cost bid by the contractor for that item.

(4) Should such actual Class 1 construction cost exceed the base price, the Class 1 compensation fee shall be reduced by 25 per cent of the excess cost up to an excess of 10 per cent and by 50 per cent of all additional excess cost above 10 per cent, provided, however, that the Class I compensation fee shall not in any case be reduced to less than 4 per cent of the base price, excepting for such payment for liquidated damages and other deductions as are provided for.

(5) Should the actual Class 1 construction cost be less than the said base price, the Class 1 compensation fee shall be increased by 25 per cent of the saving in cost below the base price up to a saving of 10 per cent of said base price and by 50 per cent of all additional saving above 10 per cent of said base price.

(6) Should the Commission grant additional time for any delay beyond the control of the contractor the minimum Class 1 compensation fee shall be increased by the sum of $2,000 per month for extended time granted.

(7) For Class 2 construction, the contractor shall receive a compensation of 4 per cent computed thereon, which shall be paid him monthly as it shall be determined to be done by the Commission.

(8) The compensation fee covers and is in payment for all and any cost and expense not included in payments for construction cost.

The base unit prices for all items except cement, lumber and steel shall be adjusted by increasing or decreasing the

same in the ratio that the final average wage rate, computed as herein provided, bears to the rate of fifty-seven (57) cents per hour provided. The final average wage rate shall be computed as the sum of the products of the percentage of the total Class 1 construction cost included in each monthly estimate multiplied by the average wage rate for the best grade of common labor prevailing in the Bureau of Water, Department of Streets and Public Improvements, of the City of Newark, during the same estimate period. For the purpose of computing the final average wage rate, the cost of cement, steel sheet piling and lumber shall be omitted from the Class 1 construction cost.

The base price for reckoning the contractor's compensation fee for Class 1 construction as provided shall be calculated by multiplying the quantity of each item by its respective base unit price or adjusted base unit price and adding the products. The contractor's compensation fee shall be reckoned in accordance with the provisions herein contained and when added to the construction cost and other moneys due the contractor as herein provided for, shall constitute the final estimate.

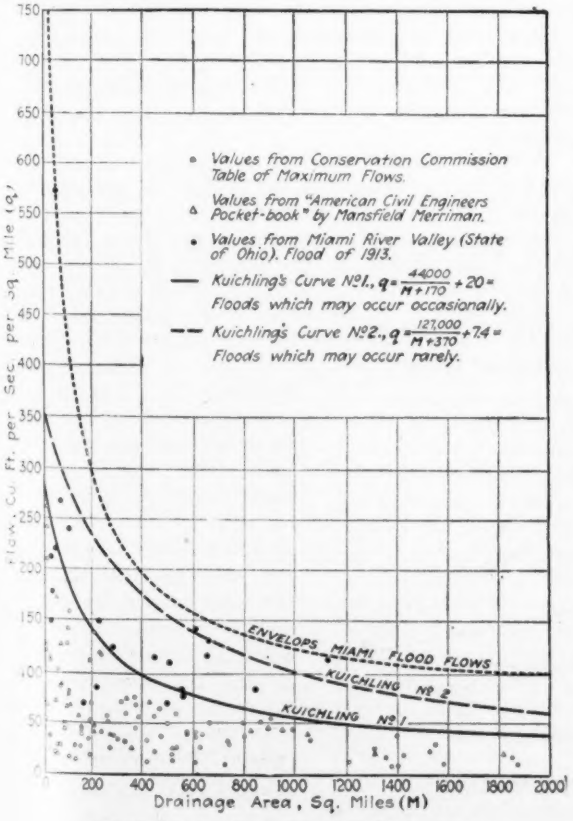
Maximum Flow of Streams in the State of New York

By E. H. Sargent

Senior Assistant Engineer, New York State Conservation Commission, Albany, N. Y.

THE results of a study, made by the writer, of the maximum flow of streams in New York State are shown on the accompanying diagram.

A search was made of all known authentic records of flood flows of streams in this state, and these are shown by the circles on the diagram. These values are not all strictly comparable, for the reason that some of them are actual maxima, while others are the flows corresponding to the highest reading of gages that are read twice a day. In addition, there have been plotted, using the triangles as a legend, values of flood flows of New York State streams given in Merriman's "American Civil Engineer's Hand Book." There is also shown, by the squares, the values of flood flows of streams in the Miami River valley in the State of Ohio during the extraordinary flood of March, 1913. These latter values were taken from tables in Part IV of the Technical Reports of the Miami Conservancy District. An inspection of this district made by the writer shows that its topography is not dissimilar from that of many of the streams in New York State and that, although the flood flows which obtained in this flood greatly exceeded any known value of floods in New York State, it is entirely within the realm of possibility that such flows might occur on some New York streams.



FLOOD FLOWS IN NEW YORK STATE

In making an investigation, in 1901, of the water supply of the new Barge Canal, the late Emil Kuichling made an exhaustive study of the maximum flood discharge of certain American and European rivers under conditions comparable to those in the Mohawk Valley. As the result of these studies he plotted two curves which are shown on the diagram. Curve 1, for occasional floods, just envelops all the values of flood flows in New York State; curve 2, for rare floods, envelopes most of the flood flows of the famous Miami River flood. There has also been drawn on this diagram a curve just enveloping these latter flows.

Contract for South American Railway

RECENTLY a contract was signed between the Bolivian Government and a firm in Buenos Aires for the construction of the railway between La Quiaca in Argentina and Tupiza in Bolivia, a distance of 57 miles. According to the terms of this contract, construction is to proceed at once with the materials now in possession of the Government, and the line is to be finished as far as the Yaruma station within four months from the signing of the contract. The entire line must be completed within 24 months. As fast as the rails are laid the line is to be opened to traffic and the contracting company is to be responsible for the maintenance of the line for a year after its opening. At the expiration of that time it is to be delivered to the Government for operation as a State line. The company has deposited a guaranty of 200,000 bolivianos (1 boliviano = $0.3893) with the Government, which will, moreover, withhold 5 per cent of the monthly payments to the contractors until the completion of the line. The plans of Vezin et Cie, former contractors, whose contract was annulled in 1919, have been incorporated in the new contract except for certain modifications in the specifications.—*Commerce Reports.*

Abandoned Canals Made Into Fish Hatching Ponds

Portions of the old Erie and Champlain canals have been transformed "into ponds for the propagation of some of the warm water food and game fishes," according to the 1918 report (just published) of the Conservation Commission of the State of New York By this means a small expenditure has provided a "pond cultural area" which is more than fifteen times as great as all of the area at the State hatcheries and in excess of the pond cultural area of all the hatcheries of the U. S. Bureau of Fisheries.

A Self-Checking String Polygon

New Graphical Method in Which Paralleling Is Replaced by Measurement Gives Increased Accuracy

By Theodore Bleckmann
Cleveland

THEORETICALLY, the graphical method of determining the reactions and bending moments in a horizontal beam on two supports under a stationary or moving system of vertical loads, has some marked advantages over the analytical one. Most conspicuous among these is the direct and positive manner in which the finished string polygon locates the critical forces and moments, as compared with the slow experimental process by which this location is determined in the analytical method. In actual practice, however, the unquestionable theoretical advantages of the method are partly neutralized by certain practical difficulties in constructing the string polygon, which may be summarized as follows:

1. It is not possible to predict closely the shape of the string polygon corresponding to a given force diagram, and therefore it is difficult to assign a desirable shape and location to a string polygon to be constructed by the judicious choice of the force diagram.

2. Cumulative inaccuracies are not easily avoided in the unwieldy process of paralleling strings and rays by means of the standard drawing triangles.

3. A simple visual check on the correctness and the accuracy of the results is absent; this is a specially undesirable feature.

By slightly modified application of the well known geometrical properties of the string polygon, however, a method is produced in which these undesirable features are practically eliminated. From Fig. 1, which shows a string polygon constructed in the customary manner by means of a force diagram there follows:

$$\left.\begin{aligned} &\triangle CET \text{ similar to } \triangle bcP, \therefore CE = \frac{bc \times Ap_1}{H} = \frac{P_1(L-a_1)}{H} \\ &\triangle DFV \text{ similar to } \triangle deP, \therefore DF = \frac{de \times Bp_3}{H} = \frac{P_3 a_3}{H} \\ &\text{By like reasoning, } EG = \frac{P_2(L-a_2)}{H}; \\ &GK = \frac{P_3(L-a_3)}{H}; \quad JL = \frac{P_1 a_1}{H}; \quad JF = \frac{P_2 a_2}{H} \end{aligned}\right\} \quad (1)$$

Further,

$$\left.\begin{aligned} &\triangle AS_1p_1 \text{ similar to } \triangle AO_1O, \therefore S_1p_1 = \frac{O_1O \times Ap_1}{AO} = \frac{P_1(L-a_1)}{H} \\ &\triangle BR_2p_2 \text{ similar to } \triangle BO'_2O', \therefore R_2p_2 = \frac{O'_2O' \times Bp_2}{BO'} = \frac{P_2 a_2}{H} \\ &\text{By like reasoning, } S_2p_2 = \frac{P_2(L-a_2)}{H}; \\ &S_3p_3 = \frac{P_3(L-a_3)}{H}; \quad R_1p_1 = \frac{P_1 a_1}{H}; \quad R_2p_2 = \frac{P_2 a_2}{H} \end{aligned}\right\} \quad (2)$$

And also,

$$\left.\begin{aligned} &\triangle WZC \text{ similar to } \triangle bfP, \therefore WZ = \frac{fb \times AO}{H} = \frac{R_A \times H}{H} = R_A \\ &\triangle MND \text{ similar to } \triangle feP, \therefore MN = \frac{fe \times BO'}{H} = \frac{R_B \times H}{H} = R_B \end{aligned}\right\} \quad (3)$$

Inspection of equations (1) and (2) shows that $CE = S_1p_1$, $EG = S_2p_2$, $GK = S_3p_3$, $DF = R_1p_1$, $FJ = R_2p_2$, $JL = R_1p_1$. From these equalities there follows a simple method for constructing the string polygon.

Assume a polar distance H and lay it off as AO from the left point of support A to the right on the axis AB; at point O erect a vertical OO_n. On OO_n in upward direction lay off each external load P from the same point O and connect the end points O_1, O_2, O_3, etc., with A by means of the rays s_1, s_2, s_3. From an arbitrarily selected point C of the vertical AK through A, lay off on AK in downward direction each segment B_nP_n intercepted by the axis AB and the ray s_n on the vertical load line P_n to which that ray corresponds, in the order in which they are passed in going from A to B. By the same procedure used in locating points O_1, O_2, O_n, locate now the points O'_1, O'_2, O'_n, etc., starting however, from the right-hand point of support B instead of from A, using the same polar distance H and the same scale of forces. Connect the O' points with B by means of the rays r. From an arbitrarily selected point D of the verti-

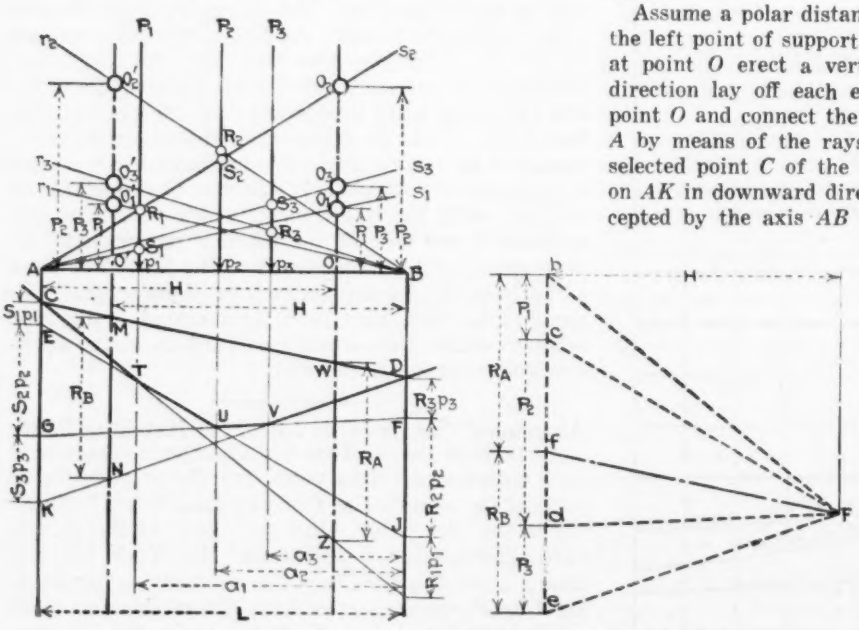


FIG. 1. METHOD OF DRAWING STRING POLYGON BY SCALING

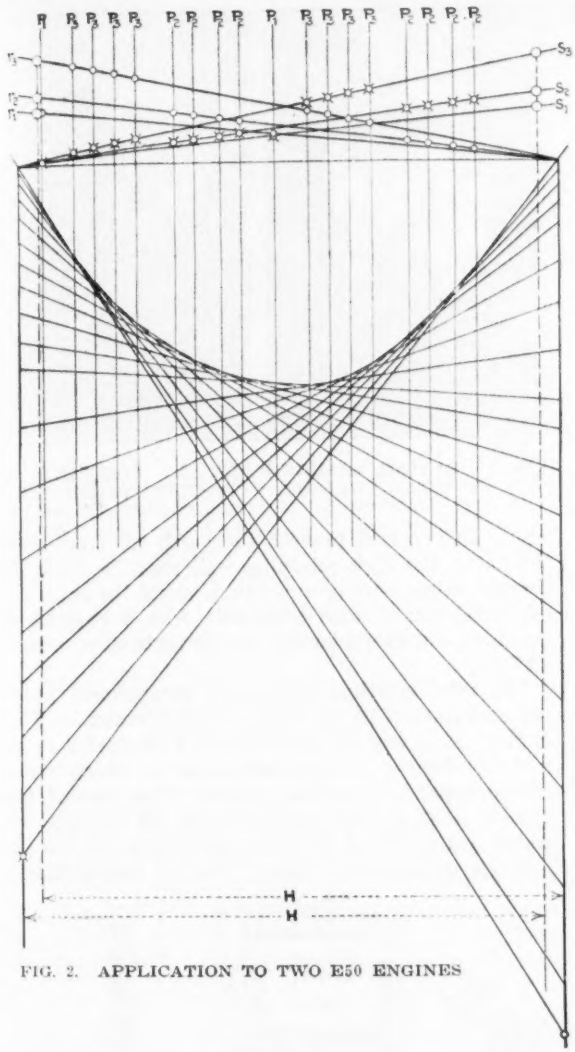


FIG. 2. APPLICATION TO TWO E50 ENGINES

cal BL through B, lay off on BL in downward direction each segment R_nP_n, intercepted by AB and ray r_n on the vertical load line P_n to which that ray corresponds, in the order in which they are passed in going from B to A. After this, merely connect each point on AK with its corresponding point on BL, and the string polygon is complete.

With this method, in each particular problem it is easy to estimate in advance the maximum required drawing space above the axis and under the closing line. For, the points C and D being arbitrarily selected, it follows that the direction and location of the closing line may be arbitrarily selected in advance. Furthermore, by sketching in a tentatively assumed length H, the greatest load P_n on a tentatively assumed scale of forces, and the two rays corresponding with that greatest load, it is possible to obtain at once the maximum required vertical clearance above the axis; the sum of the segments cut off from the vertical load lines by the axis and either the one or the other of these two upper rays (whichever gives the largest sum), is always greater than the maximum required vertical clearance under the closing line, DL.

The method gives very accurate results, as it substitutes accurate laying off of distances for the precarious paralleling of lines and in addition permits the use of a large scale of forces on account of the particular manner of laying off the loads. And finally, the finished string polygon carries two distinct checks: the first one being that the sum of the two independently determined reactions R_A and R_B must equal the sum of the external loads; the second one, that each pair of strings must have their point of intersection on the vertical load line to which they correspond.

Inspection of Fig. 2, representing the string polygon for the two locomotives of Cooper's standard loading E50, shows that the method is specially adapted for loading systems consisting of a small number of different groups of many equal loads each. For such systems both the analytical and the usual graphical method grow very unwieldy, while here the construction is simple, compact and accurate. For simple cases of loading both the analytical and the usual graphical method most probably will lead to the desired result more quickly, but even in such work the new graphical method may prove useful on account of its accuracy and reliability.

Oakum and Braces Save Suspected Partition Wall in Wasteway

By H. B. Fleshman

When the earth dam of the Lyman Water Co., St. Johns, Ariz., the failure of which was described in *Engineering News* Apr. 22, 1915, p. 294, and *Engineering Record*, Apr. 24, 1915, p. 537, was redesigned, a 7 x 8-ft. wasteway was tunneled through rock at the south end of the dam and lined with concrete. As timbering was necessary in a portion of the tunnel, difficulty was encountered in placing concrete in the roof section. As a result there has always been a lot of seepage through the roof. Later it was decided to use one-half of this outlet as a pressure tunnel to deliver water to the main canal 20 ft. above and 50 ft. to the right of the lower end of the tunnel. A 6 x 6-ft. shaft and cross tunnel was built to connect with the wasteway tunnel. In the latter a 14-in. center wall was started but not completed. When work was resumed a settlement of the center wall was found leaving a space at the top the entire length of the wall varying from $\frac{1}{8}$ to $1\frac{1}{2}$ in. The wall also was left in the condition of a beam supported at one end (the bottom), and that end under suspicion of not being sufficiently strong to support a 22-ft. head of water. There was insufficient time before the irrigation season opened to line the roof and thus stop the leaks, nor could planks be fitted into the opening over the wall on account of the roughness of the concrete. Oakum was calked into the cracks with chisels and hammers. Braces of 4 x 4-in. timbers were set 6 ft. apart 4 ft. above the floor along the entire length of the waterway on the dry side. At an unusually weak spot in the roof the water broke through but was held back by a 3-ft. length of 2 x 12-in. plank fitted to the opening and wedged up by a vertical 4 x 4-in. strut. Water was turned into the canal on time and the improvised tunnel connection has been in use all season.

A leakage of about $\frac{1}{2}$ sec.-ft. comes through the roof of the "dry" side of the tunnel, but it is clear and does not seem to be doing any damage. The several second-feet coming over the top of the wall and round the upper gates is about the amount necessary to pass down the river without lifting the gates.

Stream Bed Enlargements in Kansas

Eroded Channels Lead to Culvert and Bridge Failures—Vertical Drop Concrete Box With Retained Earth Fill Solves Problem

By Dudley Alkins, Jr.
County Engineer, Doniphan County, Kansas

In *Engineering News-Record*, May 20, editorial comment appeared on small highway bridges failing because of foundation weaknesses. We have a situation in this county which is not explained in texts or journals. This situation concerns the enlargement of stream beds and the subsequent engulfment of small bridges and culverts, footings and all.

Fig. 1 shows in the foreground, the original size of a channel draining 1,000 acres, being 30 ft. wide and averaging 8 ft. deep. Formerly, the creek turned to the left in the distance and meandered a mile to the Missouri River. Last year the Missouri River eroded the intervening fields and intercepted the drainage at a near-by point. There was a difference in elevation between the creek bed and the river of approximately 10 ft. so that the alluvial soil of the creek channel was easily cut back upstream during each freshet. The enlarged channel is 70 ft. wide and 15 ft. deep. The

FIG. 1. STREAM BED ENLARGED BY CHANGE IN MISSOURI RIVER CHANNEL

central part of the channel washes back, causing the banks to cave and slide. It was during the sliding that ten cedar piling were snapped off and a small iron bridge dropped into the new and larger channel. Such enlargements as illustrated in Fig. 1 continue for mile to the very end of each branch, but on a smaller scale. Doniphan County is mostly upland with loess hills adjoining the Missouri River bottom land, and offers short and steep creek channels leading back to the higher country.

The ravine shown in Fig. 2 drains 14 acres. The wood bridge is 32 ft. long and 21 ft. above the waterway and only during rains is there any water passing through. The plan in Fig. 4 represents the box culvert which is to be built at this place. The purpose is to make an earth fill which will act as a dam and divert the storm water through the drop inlet to a vertical fall of 19 ft. There will be considerable impact from the force of the descending water which the extra thickness and reinforcing at the base of the inlet is to care for. It must be remembered that water flows through this culvert only during rain and probably amounts to 24 hr. of full capacity per year.

There is considerable economy in building a long culvert barrel and a low retaining wall at the outlet, as an alternative for a short barrel and high retaining

FIG. 2. RAVINE DRAINING 14 ACRES STILL BEING ERODED

FIG. 3. CONCRETE BOX CULVERT UNDERMINED BY ENLARGED STREAM BED

wall. In order to prevent the earth fill from closing the outlet the high retaining wall must be quite long, thereby using more concrete than would the extra 20 ft. of barrel and a small headwall. Fig. 4 requires 45.9 cu.yd. of concrete whereby an alternate plan uses only 22.7 cu.yd.

The most startling stream-bed enlargement problem yet encountered in the county is illustrated by Fig. 3. Eighty acres are drained through a channel 8 ft. wide and 2 ft. deep to a 4 x 5-ft. concrete box which is shown in the upper part of the picture. The channel downstream is 33 ft. deep and averages 30 ft. wide. The water has a fall of 27 ft. in one stage. A few years ago the downstream channel was no larger than the

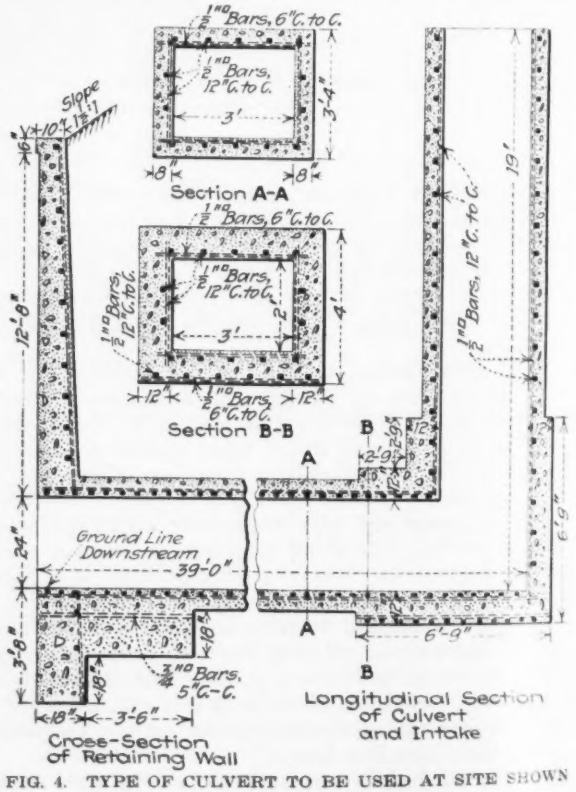


FIG. 4. TYPE OF CULVERT TO BE USED AT SITE SHOWN IN FIG. 2

upstream channel. The engineer who planned this culvert could hardly have foretold what would happen. Obviously no standard culvert footing would serve. Neither could any ordinary standard culvert last much longer, but had the present culvert been properly reinforced it would have been possible to build a concrete drop outlet in such a way as to hold the water harmlessly within walls instead of allowing it to erode further. A staircase flume was under consideration but as yet no definite plan has been arrived at.

The Kansas State Highway Commission requires standard field notes with each plan submitted for approval. One of the questions is "Is the stream cutting or filling?" We go that question one better before even deciding to build a concrete culvert by hiking downstream from the culvert site to find out if there are any stream-bed enlargements coming. When we find such a situation the proposed improvement is postponed, or, if urgent, is built of piling and planks. Most of this season's work is in mature stream beds, but some preventive work has been done to save good concrete culverts so endangered.

Wire Mesh Used for Concrete Flat Slab Reinforcement

Shortage of Steel Bars Leads to Adoption of Woven Wire for Secondary Bands of Girderless Floor

By S. Goldstein

Formerly Designing Engineer, John Monks & Sons, New York City, Now with Fred T. Ley & Co., New York City

On account of the difficulty of obtaining reinforcing bars, especially of the smaller sizes, wire mesh was used for the secondary bands of the flat-slab concrete floors of a recent warehouse building near New York City. For the main bands, where larger sections were required, the usual bars were used. In the absence of any building code regulating the flat-slab design, the writer used a combination of the Chicago and Corrugated Bar Co.'s regulations in computing and proportioning the moments over the various parts of the floor.

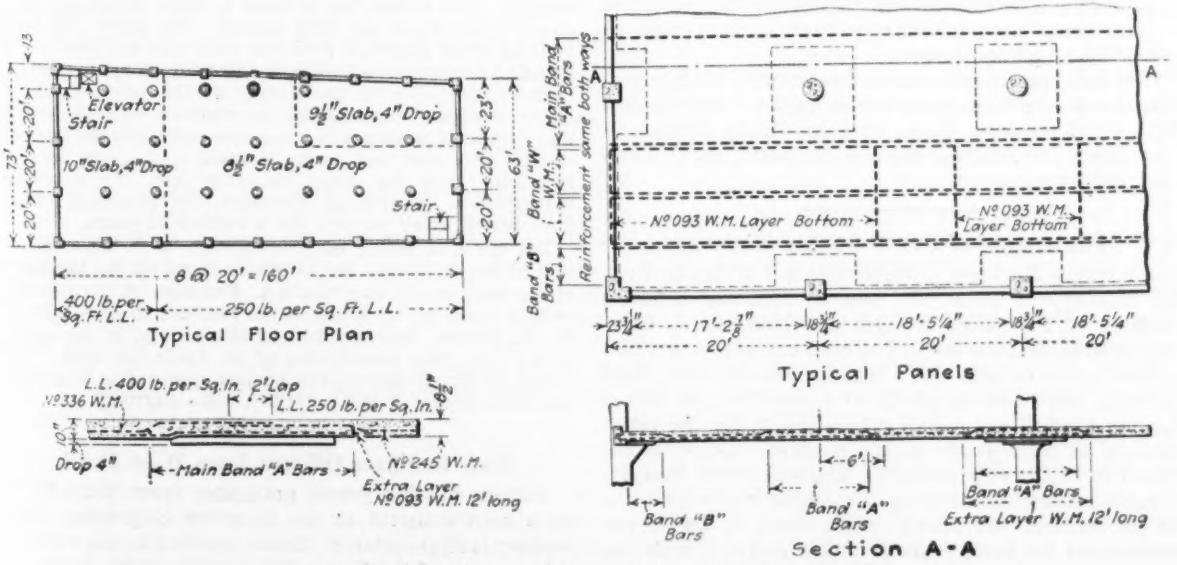
The building is of an irregular shape, being 160 ft. long and 63 ft. wide at one end and 73 ft. at the other end. The columns are 20 ft. centers, making the typical floor panels 20 ft. by 20 ft. The live-load on the floor was not constant, being 400 lb. per square foot over the first two bays from the wider end and 250 lb. per square foot for the rest of the floor areas.

The details of the reinforcement are shown in the accompanying darwings. At the mid-section where the secondary band crosses the main band the moment is negative and the wire mesh is hickeyed over the main band, leaving a long stretch (about half the span) without any reinforcement in the bottom of the slab. In ordinary all-bar design this is overcome by having part of the reinforcing bars (usually half) extended up to a short distance from center line of column. Where wire mesh is used it would be bad practice to cut abruptly all the positive reinforcement even along a line theoretically very nea the point of inflection. This difficulty was overcome by using a short band of wire mesh of small cross sectional area at the bottom of the slab over the main band long enough to lap about a foot with the secondary band before the latter is hickeyed up.

The wall panels, where the steel reinforcement ought to be increased due to the lack of continuity, an extra layer of wire mesh, of sufficient area to make up the necessary increase (about 20 per cent), was used and this extra layer was continued at the bottom of the slab into the wall spandrel on one side and over the main band to lap with the same band with the next panel.

One of the details shows the method of splicing two bands of wire mesh of different cross sectional areas where the live-load changes from 250 to 400 lb. per square foot and also where a long panel meets a regular 20 ft. panel.

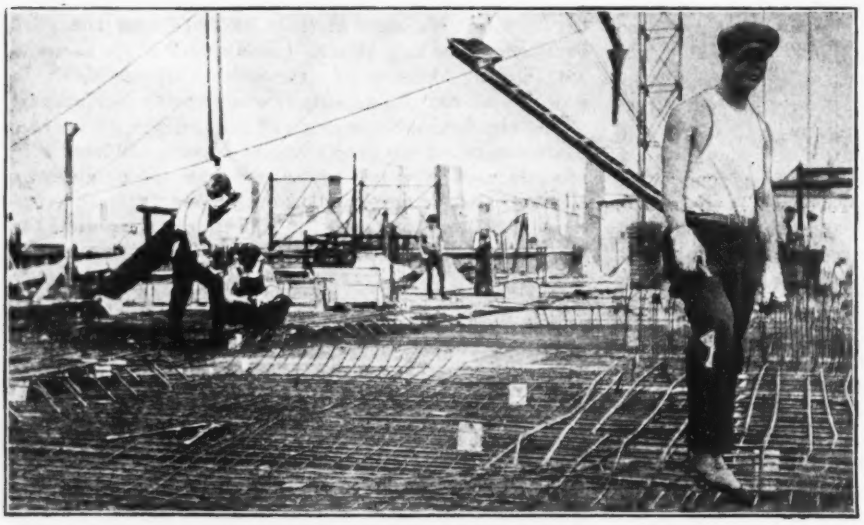
An examination of the reinforcement in place before the concrete was poured showed that ordinary care was sufficient to avoid unnecessary congestion of the steel reinforcement with the exception of the corner panels where four layers of wire mesh had to be placed. For this reason the writer found it advisable to use bars in one direction and wire mesh in the other in the second-



FLAT-SLAB FLOOR USING WIRE-MESH REINFORCEMENT

ary bands of the corner panels of the upper floors, thereby avoiding excessive congestion of steel.

No difficulty was encountered in keeping the steel in proper position. The wire mesh was supported on bars, which in turn were supported on precast concrete stools. By the use of a hooked bar the wire mesh was lifted to proper position while the concrete was being poured. The cost of handling, bending and placing the wire mesh was considerably less than for reinforcing bars.



PLACING THE WIRE MESH IN THE FLAT SLAB FLOOR

The writer is of the opinion that because of the higher quality of steel and better continuity of the wire mesh, a higher working stress is permissible for the wire mesh than for bars, i.e. 18,000 lb. instead of 16,000 lb. per square inch. By the use of wire mesh for the secondary bands only, excessive steel congestion is avoided and the combination of wire mesh and reinforcing bars produces a structure more economical and at least as good as the ordinary all-bar design.

The building described is a three-story flat-slab reinforced-concrete factory-warehouse built for the Vacuum Oil Co., of Bayonne, N. J., by John Monks & Sons, of New York City, contractors and engineers, W. O. Hoffman, chief engineer.

Maintenance of Devon County Highways

Sir Henry Maybury, Director General of Roads, British Ministry of Transport, recently appeared before a meeting of the Devon Bridges and Main Roads Committee to explain the method of road classification which is now going on and which will become effective April 1, 1921, but more especially to plead that the Devon County Council assume all responsibility for the maintenance of main roads within its area. Devon is believed to be the only county in England which does not directly control maintenance of the main highways within its borders. At present main roads in Devon are maintained by rural councils under contract with the county council.

Sir Henry Maybury pointed out that when the Ministry assumed responsibility for the maintenance of first and second class roads April 1, the case of Devon could be more easily disposed of were all maintenance authority centralized in one governing body.

Relation of Zoning to the Work of the City Engineer

By E. S. Rankin
Engineer, Bureau of Sewers, Newark, N. J.

Extracts from a paper read before the American Society for Municipal Improvements, St. Louis, Mo., October, 1920.

In a city in which a stringent zoning ordinance is in force, the element of chance in the engineer's work is largely eliminated and decided economies effected, whether it be in the laying out of streets, or in their paving, sewering, or water supply, for it is obvious that with the assurance that a given section of the city will be occupied by a certain definite class and size of buildings, the engineer can much more intelligently design the public works necessary to properly serve that section.

With zoning ordinance in effect a street system can be laid out with streets of such width and such distances apart as best to serve the use to which the land will be put, and with the assurance that such use will be permanent. Parks and playgrounds can also be located where they will permanently be of the greatest service to the greatest number.

Perhaps the most obvious effect of which zoning will have on public improvements will be in its relation to the paving problem. In an industrial district durability and strength to carry the heaviest traffic will be the first consideration, while smoothness with an absence of noise will govern the selection of a pavement for a residence district. Of course these features are given consideration without a zoning ordinance, but there is no assurance that the character of the district will not change and the pavement become unsuitable. The writer has in mind a street in his own city paved a few years ago with telford. The street was well built up at the time with moderate sized one- and two-family detached houses, but adjoining a new railroad spur. Almost immediately following the paving of the street factories began to appear, attracted by the railroad, with the result that inside of a year the pavement was sadly in need of repairs and soon had to be replaced with more durable material. Had the street been restricted by a zoning ordinance to its original character, the pavement would have served every purpose for a number of years.

The effect of zoning on sewer design, with the substitution of known factors for estimates based on the judgment of the engineer, is very marked. For most of the remarks on this phase of the subject I am indebted to an article by W. W. Horner, vice-president of this society, in the report of the City Plan Commission of St. Louis for 1919. [An article by Mr. Horner on this subject appeared in *Engineering News-Record*, Feb. 21, 1918, p. 368.—Editor.]

New Engineer Officers from West Point

Fifteen of this year's graduates from West Point have been assigned to the Corps of Engineers. This number is slightly larger than is justified by the numerical strength of the Corps, but in view of the dearth of engineer officers it was regarded as advisable. These officers from West Point and thirty other young engineer officers will form the first class in the new "basic" course at the Engineer School, which future graduates assigned to the Engineers must attend.

Wet Concrete Hauled Three Miles for Pavement Base

Concrete Flows Freely After Half an Hour on the Trucks — Hydrated Lime Facilitates Spreading and Tamping

By C. B. Montgomery
Union Paving Co., Philadelphia, Pa.

Mixed concrete is being hauled an average distance of 3 mi. in constructing the concrete base for 150,000 sq.yd. of pavement at Philadelphia, Pa. Experience with wet-batch haulage has disclosed no inherent objections to the method. Samples of concrete taken from the streets show remarkable density and uniformity and have passed satisfactorily the required laboratory tests.

In preparing for operation the contractor, the Union Paving Co., built on its property at 30th and Locust streets, Philadelphia, a plant capable of producing about 800 batches, or approximately 200 cu.yd. of concrete per day, the layout of which is shown by accompanying sketch. The plant is favorably located for its purpose, being served by both rail and water transportation and centrally situated in respect to the streets to be paved. A steam-driven batch mixer of 30 cu.ft. capacity is mounted on a platform high enough to permit trucks to drive underneath. On this platform stands the mixerman, all materials and operations being under his constant sight and control and the mixed concrete subject to his scrutiny. Above the mixing drum is a divided measuring box for fine and coarse aggregates. Above the measuring box are storage bins of about 40 tons total capacity, while to one side extends a cement platform of 150 bags capacity. A 100-gal. tank on this platform with 2-in. discharge pipe furnishes a steady supply of water for mixing. The storage bins are filled from ground storage piles by a locomotive crane, which also supplies cement to the platform from an adjacent warehouse.

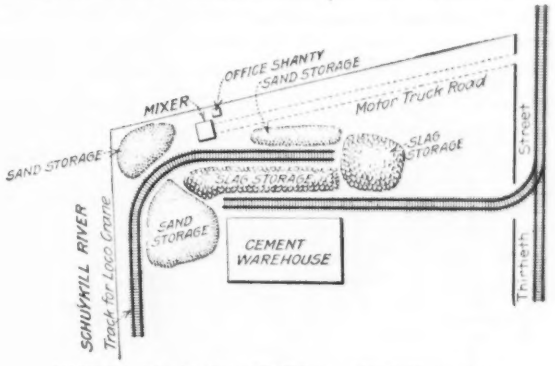
The working force for operating this plant consists of: One man opening cement bags; one man charging the measuring box; one mixer man; two men in the cement house; one handy man; one timekeeper loading and checking trucks; two men on the locomotive crane, and one foreman.

The mixture is 1:3:6, with slag as coarse aggregate. Hydrated lime is added to produce a denser, more plastic mix as well as to retard slightly the initial set. The lime proportion is 10 per cent to 15 per cent of the cement used, depending on the length of haul. A stiff consistency is maintained, about 5 per cent to 6 per cent by weight of water being used in mixing. The slag on the ground storage piles is well sprinkled before being placed in the bins, to prevent it from absorbing water from the mortar.

Two-ton dump trucks with fairly tight steel bodies are used for transporting the wet material, but no special care is taken to make the bodies watertight. Five-ton trucks were tried first and, although somewhat cheaper, it was found that the small trucks were quicker, more flexible, did not require so long a time for loading, and the smaller mass of concrete had less tendency to pack together in transit.

In central-plant concrete mixing, speed and continuous operation are important. Each truck driver is impressed with the need of delivering the material promptly and if, through accident or neglect, a load is unduly delayed it is not used but sent to a dump and the truck owner responsible is charged for the lost material. The time elapsing between the start of mixing to final placing in the street averages from 15 min. for a 2-mi. haul to 35 min. for a 5-mi. haul. The average distance from the plant to the streets is about 3 mi. Before loading, each truck body is sprayed with water and lightly sprinkled with wet sand. This prevents the wet concrete from adhering to the sides or bottom of the truck. Oil was at first used for this purpose but water proved more effective. The trucks also are covered with heavy canvas to prevent the wind and sun from drying out the exposed concrete.

Some of the advantages resulting from the central mixing plant are: More positive control, hence greater



SKETCH PLAN OF CENTRAL MIXING PLANT

uniformity of product; reduction of labor force to about one-third for equal yardage; less interference with traffic by eliminating storage piles on the street; less frequent moves, with attendant delay, transportation cost and damage to machine; maximum efficiency of plant by more continuous operation; reduced mechanical trouble with mixer by using a heavier machine, rigidly placed, together with convenience of spare parts for prompt repairs; economies through the choice of fuel for motive power as soft coal, electricity, etc., not possible with a street paver, and the saving of cement sacks formerly lost or destroyed on the street.

Suggestions from Rebuilt French Cities

Excess condemnation and final resale or leasing of lands adjacent to areas being taken for street widening and opening has enabled many cities and towns in the devastated region of France to finance the whole of these improvements. An outline of this practice, together with a suggestion that it be adopted more generally in the United States, and also that benefits as well as damages for street improvements be assessed against the abutting property, was presented at the recent meeting of the American Society for Municipal Improvements by George B. Ford of the Technical Advisory Corporation. Contrary to the generally accepted views, the French are permitting many street changes in rebuilding their cities. They are the more prone to do this since the government pays the larger part of the bill. Co-operative societies have been formed in most of the towns which enable the employment of one contractor, one engineer and one architect, instead of many of each, and to standardize the many unit parts of their buildings, such as windows and doors.

Planning the Future of the Cleveland Water Supply

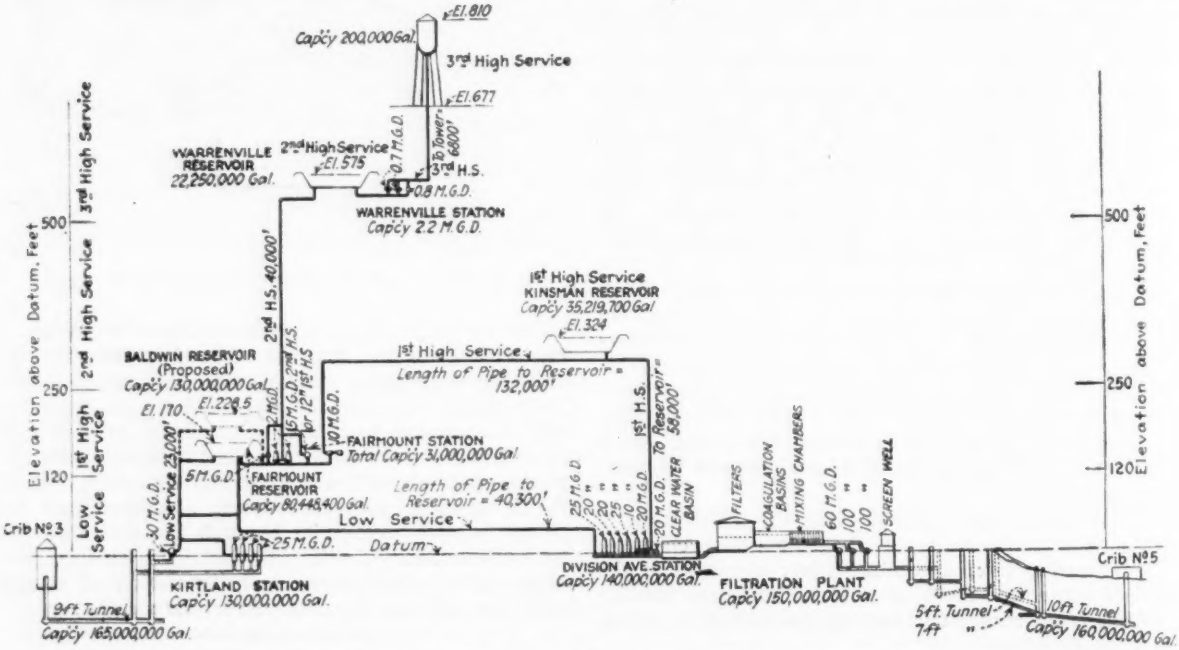
Methods Followed Lead to $30,000,000 Program by 1940 Delivering 430,000,000 Gallons Daily from Four Intakes of Which Two Will Be New

BY A. V. RUGGLES
Engineer of Construction and Surveys, Division of Water, Cleveland, Ohio

A COMPREHENSIVE plan for the future development of the water-supply system of Cleveland, Ohio, has been made by the engineers of the Division of Water. The methods of investigation pursued, the results obtained and the conclusions reached as to the program to be followed have been set forth in a pamphlet which contains a series of reports by the writer to G. B. Dusinberre, former commissioner of water, and to J. T. Martin, present commissioner of water. The program provides for Cleveland's furnishing water to an ever-widening area which has been assumed to have expanded by 1,940 to include the whole of Cuyahoga Co. together with some territory outside the county to the east and including a total area of approximately 475 square miles. Studies were carried on during the greater part of 1917, discontinued for the period of the war and resumed early in 1919. The final report of Sept. 28, 1919, gave conclusions as to future demands for water in all districts to be supplied at successive periods until 1940; and recommendation as to size, location and times of installation of the various new intake tunnels, pumping stations, filtration plants, reservoirs and main feeder pipe lines to meet these demands. In November, 1919, J. W. Frazier, J. H. Herron and Robert Hoffman were designated by Mr. Martin as a special commission of engineers to review the program of the Division of Water. Their report approved the city's plan, summarized the important features of the construction program and also urged a raise in rates for water to an extent necessary for the proper financing of work.

In 1917 the city was able to draw water from Lake Erie through two separate supply tunnels, and although pumping facilities at the two stations at the lake front were ample for immediate needs, it was apparent that in the outlying regions, and particularly in the high service districts, the existing facilities for supplying water would be heavily taxed within a few years. Subsequent events have proved this to be the case to a greater extent even than anticipated, due to the unprecedented demands for water during and since the war.

As early as 1917 it was realized that a careful study should be made of the future development of the distribution system. An investigation of the larger mains was begun by the writer, primarily to determine what additional supply mains would be needed to care for the city's rapid growth. The facts which it was deemed desirable to establish were the size and location of these pipe lines and the dates on which they should be ready to be put into service. This naturally led to a detailed study of rates of consumption, the variations in consumption in different sections of the city, maximum as compared with average consumption for the city as a whole and for the several service districts, and the probable growth and distribution of the population through the areas to be served.



DIAGRAMMATIC SKETCH OF CLEVELAND WATER-WORKS SYSTEM

Existing Arrangement of Pumping Stations, Reservoirs and Distribution System—The general layout of the Cleveland system as it exists today is shown by the accompanying

sketch. By the completion of the 150,000,000-gal. rapid sand filter plant in 1917 the city was able to secure water from two independent intakes, one supply being filtered and the other chlorinated.

Previous to 1904 the entire water supply of Cleveland was obtained from Lake Erie through an intake (crib 4), located a short distance west of the mouth of the Cuyahoga River and a mile from the shore. This intake was connected to a pumping station at the shore on Division Ave. by two tunnels, 5 ft. and 7 ft. in diameter. In 1904 a new intake (crib 3) was completed, having a permanent steel crib extending above the lake surface, together with a 9-ft. brick-lined tunnel and a pumping station. The crib is four miles from shore and in 55 ft. of water. The pumping station (Kirtland Station) which this intake and tunnel serve is at the foot of East 49th St., with a capacity of 130,000,000 gal. daily, all low service pumps.

In both pumping stations and in the filtration plant on the West Side the equipment provided was ample for immediate needs. Provision was also made to care for increased output up to the capacity of the two intake tunnels, each of which can bring in about 165,000,000 gal. daily, by additional pumps to be installed as demands should grow. Some of this water is repumped in order to meet the needs of areas of high level.

The low service district, comprising all parts of the city less than 120 ft. above lake level, has been provided with reservoir storage of 80,000,000 gal. on the east side at Fairmount. The first high service district comprises that portion of the city between El. 120 and 250, the second high service between El. 250 and 500 and the third from El. 500 to 810.

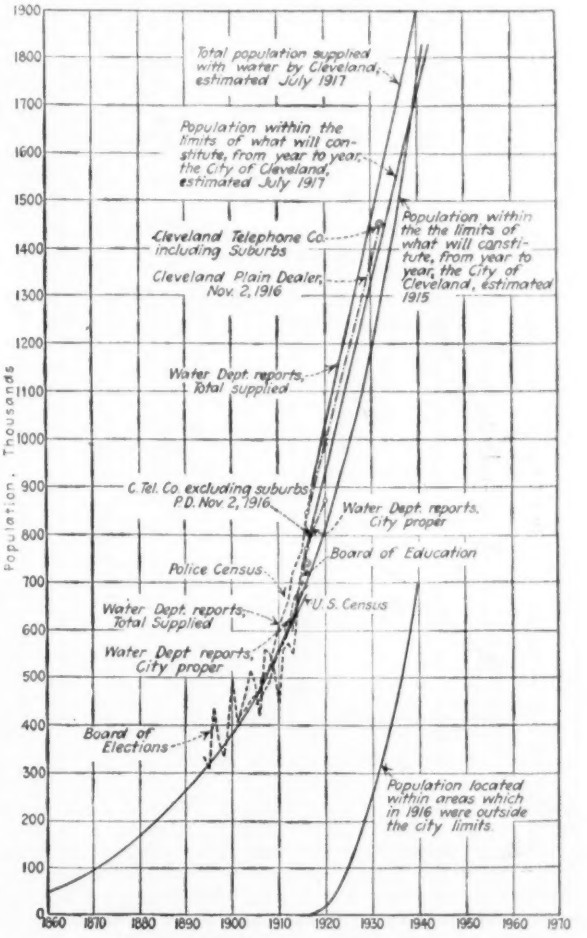
In 1913 a new low service reservoir was planned and its construction is now under way. This reservoir (Baldwin) is located just east of and 55 ft. above the Fairmount reservoir. Its capacity will be approximately 125,000,000 gal. and it will have a beneficial effect in increasing the pressure in the low service district.

Existing Conditions as to Flow in Feeder Mains—In 1919 there were built more than 30 new permanent pitometer vaults at strategic points on the large feeder mains and measurements have been taken at all these. These records show to how great an extent these main feeder lines were being pushed. The results have been reassuring, showing that the mains are, in general, ample for immediate needs; that the velocities are not excessive, and that the large mains laid in tunnels under the Cuyahoga River to connect up the East and West Sides of the city in the low service district are sufficient for the needs.

One group of pitometer vaults forms a ring around Kirtland station, each about one mile from the station, on a large main. These are of value in determining the size and location of new mains leaving the stations to care for the output of additional pumps from time to time. Another similar ring surrounds Division station. Other new vaults, scattered about the city, together with quite a number of older vaults, have enabled tests to be made, throwing new light on problems of extension of the distribution system at various locations. For example, in a general study of conditions in the first high service, 48-hr. runs were made to include a Sunday and Monday, during which time was observed not merely velocities in the mains at the pitomter vaults but also pressures at chosen points, pumpage at Division and Fairmount stations into the first high service district, and changes in flow line in the first high service reservoir at Kinsman. Such a run was made on the first day of the general strike in the steel mills in the fall of 1919 when the industrial demands for first high service water suddenly dropped. This run was repeated under conditions of normal industrial demand and again when the hot weather domestic demand had reached a peak.

Existing Conditions as to Pressure—Inspections of 30 recording pressure gages at the fire stations are made at intervals by A. G. Siedle, engineer of waste detection, and charts from the various engine houses are now mailed in once a week directly to the Division of Water.

Pressures are usually at a minimum about 9 a.m. and for each engine house gage a graphical record is kept of pressures at this time, month by month, showing the average pressure at 9 a.m. and also pressure at this time on the worst day of the month. The yearly average pressure at 9 a.m. on the same diagram shows the tendency to improve or otherwise as the years go by, and a line giving static pressure from the reservoir is of value for comparison with the actual, which latter may be higher than static, if it gets direct friction through long lines. These data are of assistance in deciding upon extensions of the



POPULATION OF CLEVELAND—COMPARISON OF CENSUS FROM VARIOUS SOURCES

distribution system and as first hand evidence when complaints come in on account of poor pressure.

Population by Districts—On one of the drawings are shown population curves for Cleveland from the U. S. Census, from the Cleveland Board of Education, from the Board of Elections, from the Cleveland Telephone Co. and from other sources. The Board of Education multiplies its returns for all parts of the city by 4.25 to give total population.

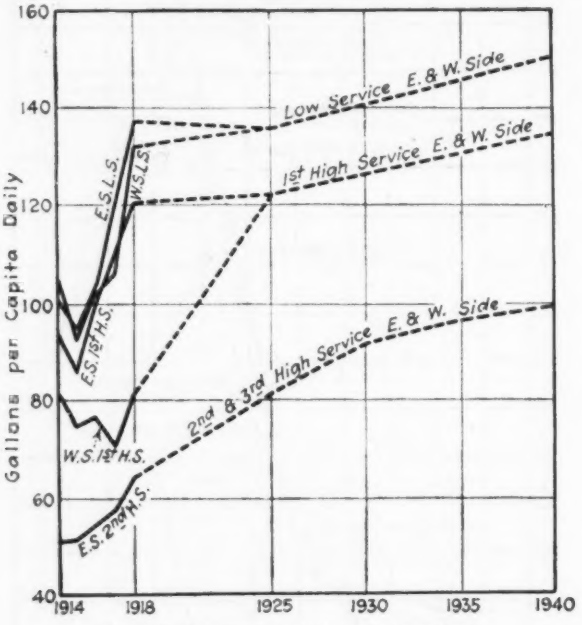
Somewhat similarly the Board of Elections' population curve is based on the number of registered voters year by year, which varies greatly from one election to another. The curves which have been plotted from the results of the Board of Elections vary so much that they are of doubtful value. The Board of Elections uses a separate factor for each ward by which it multiplies the number of registered voters to give total population.

The Cleveland Telephone Co. made careful population estimates for Cleveland, its various parts and outlying

suburbs, for the years 1916 and 1932. The results of the U. S. Census have been given especial weight in the curves adopted, and yet at the same time it is felt that these figures are too low.

In 1917 Cleveland contained, as now, 26 wards, and for each of these wards population curves were drawn, superimposed as obtained from the Board of Education, Board of Elections, the Cleveland Telephone Co. and the U. S. Census. For each of these 26 wards a curve was adopted, guided by the other four curves mentioned, and giving such populations for each ward year by year from 1890 to 1940, that for each of these 51 years the populations from the 26 curves total up to the same figure as given by the total curve.

Determination of future suburban population was guided in large degree by consideration of density or population per acre. In a rough way, taking the eight West Side



WATER CONSUMPTION BY DISTRICTS

wards, the product of the "distance from the center of a ward to the public square" times its "density of population" is a constant, the equation of an equilateral hyperbola. Similarly, for the 18 East Side wards another constant holds good in a rough way. By adopting fractional exponents for D and P in the equation D (Distance) $\times$ P (Density of Population) $=$ C (Constant), the rule was found to work better but the attempt to apply it to the suburban regions gave results varying too widely for areas so large as the groups of villages we had adopted. Drawings were prepared showing by different colors the groups of villages, their population and density for 1918 and 1940. Similar figures for each of the 26 Cleveland wards on the same map permit of comparison of adjacent or various regions and indicate the trend of growth.

Consumption by Districts—The pumpage per day per inhabitant increased with some variation from 101 gal. in 1890 to 172 gal. in 1901. At this latter time installation of meters was commenced, and when in 1909 the city had become practically entirely metered, the per capita consumption was found to have decreased quite uniformly to 94 gal. daily. Since 1909 the per capita consumption has gradually increased to 116 gal. daily in 1917. In 1918 it was 137.5 gal. daily due to the night and day operation of factories at top speed for war orders. In 1919 instead of dropping back to normal level, it remained at 130 gal. daily, and conditions so far in 1920 indicate a continued rise as compared with last year. The studies which have determined the actual rate of consumption in all parts of the city for a period of 5½ years just ended indicate unmistakably a growth in per capita consumption of water both in domestic and in industrial use. The former seems reasonable in that new houses have better facilities as to bath tubs and other conveniences than many of the houses in the older parts of the city. Factories use 60 per cent of the total consumption in the city, and all things point toward Cleveland's continuing to be a city of many large and diverse industries.

The low service district, now roughly 50 per cent of the total supplied by area and 80 per cent by volume of water used, will in a few years receive pressure from Baldwin reservoir instead of from Fairmount reservoir as now, producing an increase in head of 55 ft. or 24 lb., tending to increase both legitimate use and leakage. Being guided by these considerations we have prophesied a gallons-per-capita-daily curve for the future increasing uniformly from 130 in 1919 to 150 in 1940. This is an average for the total population supplied. Different values for this figure have been used in the different parts of the city in forecasting future demands, the forecast being guided by the recent past results.

Knowledge of per capita consumption combined with population gives a knowledge, for any year, of average daily demand. The following table shows past relation between the average and maximum daily demands:

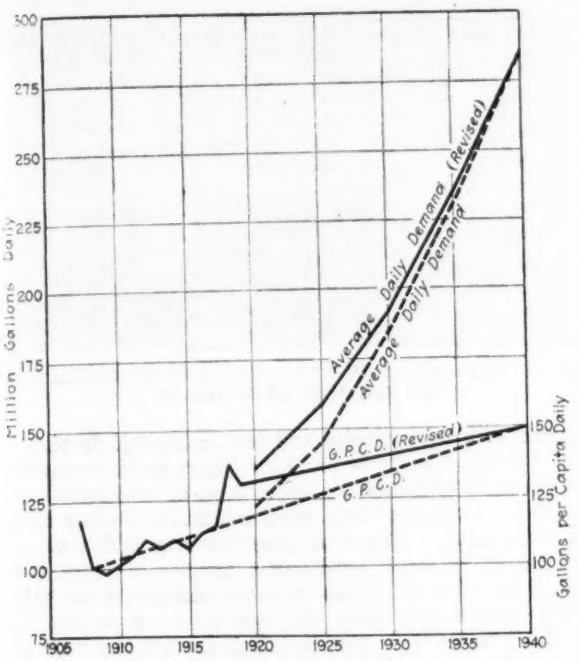
Year	Daily Pumpage. Max.	M.g.d.	Ratio	Year	Daily Pumpage Max.	M.d.g.	Ratio
1900	88.5	67.1	1.32	1910	92	61.0	1.51
1901	89	69.6	1.28	1911	100	65.7	1.52
1902	93	69.95	1.33	1912	91	73.1	1.25
1903	92	62.0	1.48	1913	107	76.8	1.39
1904	107	61.6	1.74	1914	111	82.0	1.35
1905	93	60.4	1.54	1915	111.5	80.0	1.395
1906	86	59.0	1.46	1916	127	95.65	1.33
1907	79	58.9	1.36	1917	146	103.9	1.405
1908	79	52.0	1.52	1918	177.5	123.6	1.44
1909	09.5	52.8	1.51			Average Use	1.43 1.50

The forecasts of future pump installations required have been made on the basis that in each service district there would be enough reservoir capacity to care for maximum hourly fluctuations. It was believed that, as a matter of safety, it is advisable to carry reservoirs at least to this point, and as work on installations continues, detailed studies will be made of each separate problem to determine the maximum economy as between money spent for reservoirs and that spent for pump installations.

To determine the actual rate of consumption in the various parts of the city, and the variations in these rates from time to time, a water consumption ledger was initiated in the spring of 1917 by the writer. In this were entered figures of actual consumption of water from the meter reading books for six-month periods, showing winter consumption separate from summer; large connections 1 in. and over, separate from those smaller, thus practically separating industrial from domestic use; and keeping consumption separate as between the different service districts. A continuous record of 5½ years from 1914 to 1919 has been summarized, keeping the service districts separate, and showing for this period a summation of consumption by wards as indicated by the meter readings.

Factors between station pumpage and consumption as indicated by meter readings averaged for the low service district 1.173, for the first high service 1.321 and for the second high service 1.471.

Another study shows gallons-per-capita-daily figures for each ward, year by year from 1914 to 1919, "large" and "small" connections separate, and the total of the two. The consumption indicated by meters was multiplied by the proper factor for the six-month period and the service district, to give corresponding station pumpage needs. This set of sheets showed that Ward 9, which contains the congested downtown business district, has a much higher per capita consumption than any other ward. It was therefore kept separate, in the analyses of future demands for water, from the rest of the East Side low service.



FUTURE TOTAL AND PER CAPITA CONSUMPTION

The next study gave the story of past performances of gallons-per-capita-daily station pumpage required for each service district east and west of the Cuyahoga River, and in each case what proportion it was to the gallons-per-capita figure for the entire city; and finally, graphically, were shown the estimates adopted for the future behavior of these quantities and ratios up to 1940.

For each of the years 1925, 1930, 1935 and 1940, by combining these chosen values of per capita consumption with the population in each service district east and west of the river, the corresponding demands for water were obtained.

In 1940 maximum daily demands for water will have reached the following figures:

	East of River M.g.d.	West of River M.g.d.
Low service	135.3	69.0
First high service	37.7	75.6
Second high service	49.3	7.8
Third high service	4.3	2.0
	226.6	4.4
Ward 9 low service	49.8	
Total	276.4	
Total East and West side		0.4

The maximum daily amount pumped from the lake to date has been about 170,000,000 gallons.

The Resultant Program — The figures obtained have demonstrated the necessity of having ready for use prior to 1930 a third intake crib and tunnel of a capacity of 165,000,000 gal. daily located at the eastern extremity of the city, with pumps and filters installed at first up to a capacity of 75,000,000 gal. daily, and land acquired at the outset and laid out so as to provide for ultimate extension to the full capacity of the tunnel.

Just prior to 1940 a fourth intake and tunnel of 165,000,000 gal. daily capacity must be ready for service farther west than the Division station, with pumping station and filtration plant built at first only to half capacity. Both of these stations will pump some water to the first high service, and the new East station will pump some direct to second high service. The East Side second high service reservoir will have to be increased in capacity; and a West Side first high service reservoir constructed, from which a relatively small amount of water will be boosted to a reservoir for second high and to a standpipe for third high service.

The studies have enabled a logical determination to be made of the successive pump installations needed at the four lake pumping stations, and at the inland booster stations, on both the East and West Sides of the city, to care for maximum daily demands. As pump installations are actually made, attention is paid to providing pumps in reserve, and consideration has also been given to providing enough extra pump capacity so as to be able to supply the entire demands in 1940, with any one of the four shore stations out of use temporarily, at a time of average demand. The knowledge obtained as to past and probable future demands for water in various parts of the city and country, also, has enabled computations to be made determining the size, location and time of installation of the necessary additional large pipe lines to connect up the numerous pumping stations, filtration plants and reservoirs as they are built and enlarged. The estimate of cost of the additional facilities needed in the next 20 years, exclusive of the ordinary growth of the distribution system, runs to about $30,000,000, of which one-third is to be expended within the next five years.

Waterways Contracts To Guarantee Wages and Prices

AN AGREEMENT by which the state will absorb 80 per cent of any increase above scheduled prices and wages is contained in the contract for structures for the Illinois Waterway. In case there is a decrease below the scheduled figures the state and the contractor will share equally in the saving.

If an increase in freight rates occurs, which increases the cost of materials, the state will absorb the entire increase. The base prices and wages are as follows:

WAGE SCALE

Occupation	Hourly Rate	Occupation	Hourly Rate
Blacksmith	$0.70 to $0.75	Machinist	$0.80 to $0.85
Blacksmith helper	.60 to .65	Machinist helper	.60 to .65
Boilermaker	.75 to .80	Oiler	.55 to .60
Boilermaker helper	.60 to .65	Pipe fitter	.70 to .75
Brakeman	.52½ to .57½	Pipe fitter helper	.60 to .65
Carpenter, fine	.95 to 1.00	Pump man	.60 to .65
Carpenter, rough	.70 to .75	Rigger	.60 to .65
Carpenter, helper	.60 to .65	Steel setter	.75 to .80
Derrick runner	.70 to .75	Teamster	.55 to .60
Dinkey runner	.60 to .65	Team and driver	1.00 to 1.10
Drill runner	.60 to .65	Truck driver, heavy	27.50 to 30.00 a week
Electrician	.80 to .90		
Electrician helper	.60 to .65	Truck driver, light	25.00 to 27.50 a week
Fireman	.55 to .60		
Labor, special	.55 to .60	Watchman	$100 to $110 a month
Labor	.50 to .55		

PRICE SCALE

Cement at $1.85 per bbl., net, f.o.b. cars Marseilles.
Concrete material, consisting of coarse and fine aggregate, all sizes, and of bank run gravel, at $1.05 per net ton, f.o.b. cars or boat, Marseilles, weights made by the Western Weighing Association to govern.

It is understood that eight hours shall constitute a standard day's work. Overtime in excess of eight hours shall be rated as time and one-half, and Sundays and legal holidays shall be rated as double time for wages.

Ter Meer Sludge Dewaterer at Milwaukee

At the Milwaukee sewage testing station a Ter Meer centrifugal sludge dewatering machine from Hanover, Germany, was put in operation for experimental purposes in October. T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission, in speaking of it at the recent convention of the American Society for Municipal Improvements stated that in a preliminary test a cake 4 in. thick had been obtained and that so far the machine is giving a satisfactory product. Mr. Hatton stated that the sludge varied greatly between summer and winter as to colloid content, making the operation of any press uncertain. He had therefore employed an expert in colloidal chemistry to study the colloids in sewage with a view to their control.

Well Points Used in Excavating For Beach Resort Hotel

Water Removed From Sand by Pumping Made More Difficult by Tidal Action—Costly Use of Sheet Piling Avoided

By Frank P. Kemon
Stapleton, Staten Island, N. Y.

WHAT is believed to be the most extensive excavation in quicksand ever attempted without the aid of heavy steel and timber sheet piling was successfully handled by the well-point pumping system in connection with the erection of the sixteen-story Ambassador Hotel Annex at Atlantic City, N. J.

Owing to the scarcity of steel sheet piling and the short time allotted the contractor in which to perform his contract, it became necessary to devise some means, other than that ordinarily used. The well-point pumping system was decided upon as the only method by which the work could be completed within the allotted time. James V. Ferry, treasurer of James Ferry & Son, Inc., contractors for the excavation and foundation work, who had had previous experience with the well-point pumping system, decided upon its use in this particular case.

The excavation generally was 150 ft. by 300 ft. by 18 ft. deep, and 24 ft. in machinery and elevator pits. Surface water was encountered about 3 ft. below the street level and tidewater about 10 ft. below the street level.

The pumping plant consisted of a 4-in. pipe line, laid on all four sides of the proposed excavation and about 6 ft. outside, tapped every 4 ft. throughout its entire length with 2-in. nipples and tees, connected to right- and left-hand hexagon nipples. These were connected to a 2-in. flexible metallic steam hose, in turn connected to 20-ft. sections of 2-in. pipe and finally leading to 6 ft. well points. The 4-in. pipe line was laid about 2 ft. below the street level and a number of plugs and tees were installed to dig elevator and machinery pits after general excavation had been done. A number of shut-off valves were also installed, so that any part of the main line could be cut off and greater pumping capacity concentrated at any point where it developed that it was needed. The main line was connected to four triplex pumps, one at each corner of the excavation, duplicate pumps being installed so that repairs could be made without having to stop pumping.

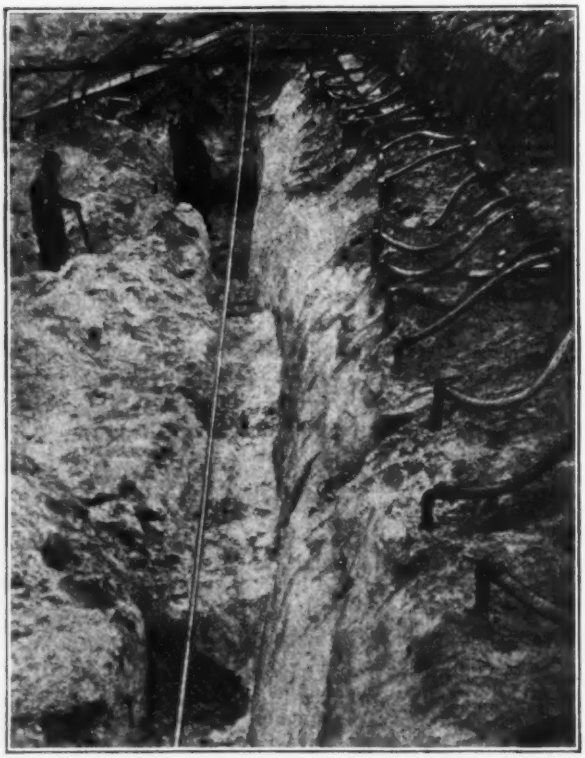


FIG. 1. WELL POINT INSTALLATION FOR AMBASSADOR HOTEL ANNEX

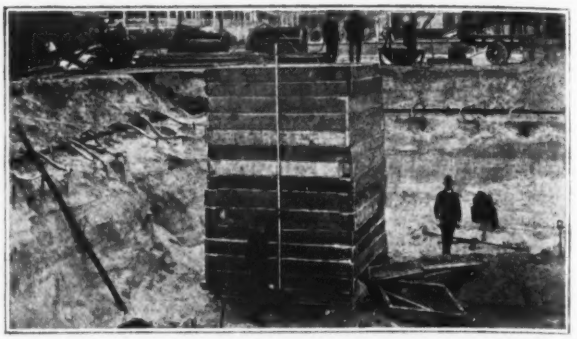


FIG. 2. EFFICIENCY OF WELL POINT SYSTEM INDICATED BY VERTICAL SAND WALLS

The 26-ft. well points were jetted into place with a 3-in. water line and the entire plant was started about a week ahead of excavation. Pumping was kept going constantly for three months after the concrete walls were finished. So successful was the system that men were able to work throughout the winter of 1919-20 in the excavation without boots. The absence of water allowed accurate tests to be carried on for determining the bearing quality of the soil. The use of piling, originally intended for the foundation, was entirely eliminated.

In order to test the bearing power of the soil a sand bin was constructed of 2-in. x 10-in. timbers with supporting legs of timbers 12 x 12 in. The bin was made 7.94 ft. long, 7.65 ft. wide, and 13½ ft. high, and successively loaded. The initial loading was 2,250 lb., the second 8,531 lb., and thereafter approximately 3,300 lb. were added in twenty-seven different stages. Readings were taken upon four nails originally set at the same elevation at the base of the bin, after each new loading. Twelve loadings and readings were made the first day, twelve the second, and five the third day. The total average settlement under a total load of 96,500 lb. was 1½ in.

The well point pumping system was kept in operation until the substructure walls and floors had been heavily waterproofed and until the permanent drainage system had been installed. The permanent drainage system consisted of the laying of a network of 6 in. porous tile pipe in gravel-filled trenches and all leading to a sump where a pump was installed with a connection to the sewer.

The hotel annex was erected at a cost of $1,500,000, Warren & Wetmore being the architects and the Thompson Starrett Co., general contractors.

Hints on the Writing of Engineering Reports

Projects Must Be Explained in Terms Which Business Man as Well as Technical Expert Can Understand

By Daniel W. Mead
Consulting Engineer, Madison, Wis.

Speaking informally before a group of Wisconsin engineers some months ago, Mr. Mead emphasized certain fundamentals in the preparation of engineering reports. In the belief that an amplification of his remarks would be valuable, not only to the young and inexperienced engineer, but also to the older members of the profession who comm t many sins of omission and commission in report writing, "Engineering News-Record" has induced Mr. Mead to prepare the accompanying article. He has had such a wide experience in the investigation of new projects that his advice on how best to present the results of such work merits careful reading.

PRELIMINARY to the preparation of an engineering report, the principal matter to be considered is the correct solution of the problem under investigation. It is a fundamental necessity that the engineering examination be so complete and the data so thoroughly studied as to result in the formation of clear and intelligent conclusions on the manner in which the development of the project should be accomplished and on its feasibility as a business venture. After this solution has been reached the important matter to be kept in mind in the presentation of the subject in the report is the capacity of the parties for whose understanding of the project the report is prepared.

When the report is prepared by an engineer for his superior, or for other engineers who are familiar with many of the details of the project discussed, it may be unnecessary and undesirable to do more than discuss that phase of the subject which has been submitted for examination. Under such conditions the report may deal solely with details in as technical a form as the understanding of the parties for whom it is written may make desirable. In any event, the men who are to read and understand the report are to be kept constantly in mind and their knowledge of the situation and their understanding of the subject should modify both the manner and the detail in which the subject is treated.

New projects, such as water power or industrial developments, irrigation, drainage, flood protection, or other similar matters, involve not only the solution of numerous intricate problems but also their explanation in a clear, logical and convincing manner to an audience of varied degrees of interest and understanding. These interested parties include the projectors and various others who may be interested as part owners of lands or investors in the property or in the securities to be issued for its development, bankers or financial investors who may contemplate furnishing the funds for construction and the engineers who may be called upon to examine into the manner and methods of development, the plans proposed and the general feasibility of the scheme outlined in the report. In such cases the preparation of the report becomes more complicated, as it must be both elaborated and simplified so as to be made available for the understanding of all those interested in any of its phases.

Under such circumstances the needs of all the various readers should be clearly kept in mind and the report so prepared that the kind of information sought by each reader will be readily available. Commonly the banker or financier can know little of the technical details of a project and will seldom attempt to acquire such detailed knowledge. He will base his judgment of the project on his confidence in the opinion of the expert who has made the investigation or whom he may have chosen to examine the property and pass on its feasibility. He is particularly interested in the conclusions, and commonly confines his attention largely or entirely to the final opinions expressed. For this reason it is usually desirable that such conclusions be explained in a concrete and condensed form embodied in a page or two of the report and as a part of its closure. It is sometimes found more satisfactory to embody these conclusions or findings in a brief introduction to the report, as a part of the letter of transmittal. When such a report is intended to appeal to business men, projectors or investors in the proposed project, the body of the report should be written with these parties in view. There are few projects of this kind which are so complicated that they cannot be explained in simple and untechnical language, so that any good business man can understand the basis for the conclusions and their validity. An exception may be made for some of the technical features, for which the business man must depend upon the integrity and ability of the experts who have made the original investigation or those who have been called in to review the same. For these reasons purely technical details, as a rule, should be omitted from the main body of the report and the project should be presented clearly and logically and simplified as far as possible.

The third class of readers for whom such a report must be prepared comprises the technical experts who may be called in by the financial interests to pass upon the correctness of the conclusions drawn and the general feasibility of the project. These men are necessarily interested not only in the explanation of the project as a whole and the conclusions arrived at by the authors of the report, but also in the technical features on which the conclusions are based. It is therefore desirable for the benefit of such experts, and in order to save time and expense in the investigation, that there should be attached to the report, in the form of appendices, a presentation and discussion of technical details so complete that the technical advisers

may ascertain without unnecessary research all the data on which the conclusions are based, their source and reliability, the scientific basis on which the conclusions are based, and the principles on which the conclusions depend. Formulas used and methods of computation, especially where more than one method might possibly be used, should be given, and the solution of complicated problems should be shown at least in general outline.

Form of Presentation

Photographs, drawings and diagrams are frequently helpful in the description of locations and material conditions. All illustrations should be clearly made, properly titled and so numbered or lettered that they may be referred to definitely in the text and may be found easily when reference is made. In the main report side or center headings should be so frequently used as to indicate clearly the subject discussed in each section. A table of contents should be included, giving in proper order the page where each subject is discussed, the appendices and their sub-headings, and the list of illustrations and tables.

If the project is sound, its presentation in the manner suggested should not be difficult, provided that the engineer on his part can offer a satisfactory solution. Failure to arrive at clear and definite conclusions, or to make plain to the business man the methods of solution and the advantages to be derived, will render the consummation of the project doubtful. A failure to give the fundamental data on which the conclusions are based—or at least to point out their source—may involve large and unnecessary expense and delay and possibly unfavorable reports from experts who might otherwise accept and confirm the conclusions reached.

A careful preparation of a report in the manner outlined above will greatly facilitate the understanding of the project on the part of all those who may be interested and will result in a considerable saving of time, energy, and expense in the preliminary stages of promoting and financing a project.

Advantages of Lining Irrigation Canals

In the report making recommendation as to methods and designs suited to conditions on the proposed Columbia Basin irrigation project, the commission advises that the supply canals be lined with concrete and gives the following reasons for this decision: (1) Such lining permits the use of higher velocities than could be allowed in earth canals. (2) The higher velocity permits the use of smaller cross-sections with less expense for excavation. (3) A smaller cross-section of canal is practical to construct on hillsides where a larger canal might be impossible. (4) Lining reduces the seepage losses to a negligible amount. (5) The low maintenance of a lined canal is much less than that of an unlined canal. (6) The volume of water in the canal is comparatively small and easier to dispose of when shutting down. (7) Concrete lining permits the use of a section with highly desirable hydraulic properties and maintains the banks so as to retain those qualities. (8) Concrete lining avoids the perforation of banks by burrowing animals, the erosion of the banks by wave action in the canal and the growth of brush and weeds where they will interfere with the flow of the water.

Diagram to Determine Horsepower of Gasoline Engines

Eight Years' Experience in Selecting Engines for Dragline Excavators Indicates Swedish Formula Best for Purpose

By C. E. Lounsbery
Assistant Engineer, U. S. Reclamation Service, Denver, Col.

IN SELECTING a gasoline engine for use in construction plant or for similar purposes, special attention should be given to the power requirements, since both over-powered and under-powered engines are uneconomical. There are two methods of selecting an engine. One is to calculate the horsepower by some formula involving the dimensions and speed of the engine and then select an engine having the required dimensions and speed. The other method is to select from a manufacturer's catalog, relying on the power as rated therein. For the first method, one is confronted by various empirical formulas which do not check each other. For the second method, it will be found that the rated horsepowers given by manufacturers mean very little. A conservative manufacturer will base the rated horsepower on continuous operation over long periods of time, while a liberal manufacturer will base it on that developed by the Prony brake test during a trial run. Frequently the catalog fails to give the speed upon which the rated horsepower is based.

In general it is best to adopt a formula for use in selecting engines. There are numerous empirical formulas used to calculate horsepower, most of which are accurate enough under certain running conditions and for certain types of engines, but are not suitable for general field use. The three most worthy of mention are the following:

(1) The S. A. E. (Society of Automotive Engineers) formula,

$$b.hp. = \frac{D^2N}{2.5}$$

(2) The British formula,

$$b.hp. = 0.45(D - 1.18)(S/D)$$

and

(3) The Swedish Royal Automobile Club's formula,

$$b.hp. = \frac{D^2SnN}{C}$$

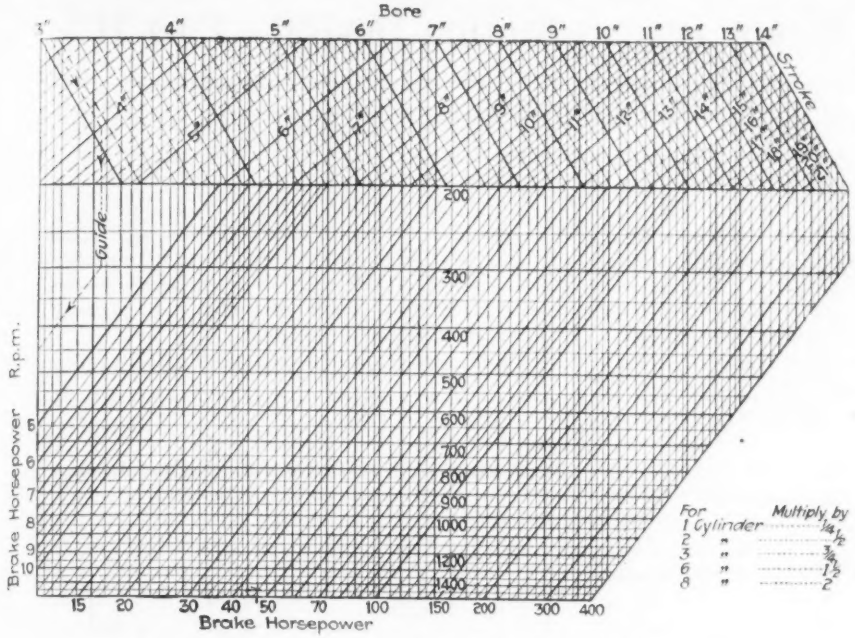
In the above formulas $b.hp.$ = brake-horsepower; D = bore in inches; S = stroke in inches; n = number of cylinders; N = number of revolutions per minute; C = a constant.

The fiirst (S. A. E.) formula is a good example of those which are suitable for certain specific conditions. The form shown above is a reduction from

$$b.hp. = \frac{PASnE}{33{,}000 \times 4}$$

considering a four-cycle engine, in which $b.hp.$ = brake-horsepower; P = mean effective pressure per square inch; A = area of piston in square inches; S = piston speed in feet per minute; D = number of cylinders; E = efficiency of the engine.

The latter form embodies all factors necessary for the calculation of horsepower, but is difficult to use



BRAKE HORSEPOWER FOR FOUR-CYLINDER GAS ENGINES

because the mean effective pressure and the efficiency must be assumed. The reduced form makes these assumptions as well as the assumption for speed. The assumptions made are (1) that all automobile engines will deliver their rated horsepower at a piston speed of 1,000 ft. per minute; (2) that the mean effective pressure is 90 lb. per square inch, and (3) that the mechanical efficiency of the engine is 75 per cent. At the present time most automobile engines deliver their maximum power at a piston speed of about 1,500 ft. per minute. Certain assumptions must be made also for the British formula.

The Swedish formula is adapted to any type of engine. Its value lies in the fact that it takes account of the cylinder dimensions and the speed, which makes it possible to compare engines upon a rational basis. In the original formula, the value of C was taken as 15,240. The modern engine, due to improved design and construction, is much more efficient than the earlier engines, which has led to the adoption for C of a value of 13,000 for four-cycle engines and 10,000 for two-cycle engines. These values are recommended in the 1918 edition of Dyke's *Automobile and Gas Engine Encyclopedia.*

This formula gives the approximate horsepower which the engine should develop when new, as shown by the Prony brake test. After a period of use the engine will become less efficient, due among other things to wear and deposits of carbon, and will not deliver the calculated horsepower during long periods of continuous operation. This fact must be considered in selecting an engine.

Engineers of the U. S. Reclamation Service have adopted the Swedish formula, and have reached the conclusion that an engine should show by this formula a rating 25 per cent in excess of the power actually required. This value is chosen arbitrarily and should not be taken with too much assurance. The experience of the engineers of the Reclamation Service has extended over a period of about 8 years. During this period dirt moving machines of various kinds have been operated at isolated points in the West but the greater part of their experience has been with drag-line excavators. These machines operate under severe conditions, often running three eight-hour shifts per day for six days in the week. This service requires efficient, well-built engines of the heavy-duty type.

The accompanying diagram was made for four-cylinder engines, using the Swedish formula with a value for C of 13,000. The range in sizes is from 3 x 3 in. to 14 x 21 in.; in speed from 200 to 1,500 r.p.m. and in horsepower from 5 to 400. On the right-hand side of the diagram are given factors by which the horsepower for a four-cylinder engine may be multiplied to obtain that for one-, two-, three-, six- and eight-cylinder engines. For example, suppose it is desired to find the horsepower of a six-cylinder engine having a 6½-in. bore and 8-in. stroke, running at 500 r.p.m. Enter at the top of the sheet with 6½ and follow the line to the right and down till it intersects the stroke line 8 running diagonally in the opposite direction. Follow vertically downward from this point until the horizontal (r.p.m.) line marked 500 is intersected. From this point follow to the left and down, estimating between lines, and read at the bottom, 52 hp. At the right of the diagram find the factor to be applied for a six-cylinder engine. Multiplying 52 by the factor 1½ gives 78 hp. which the engine should develop by brake test. This engine should reasonably be expected to develop about 62 hp. under severe working conditions.

The diagram was drawn for four-cylinder engines because the writer was particularly concerned with engines of that class. Probably it would be easier to use if it were drawn for a one-cylinder engine. The factors to be applied for other numbers of cylinders would then be whole numbers instead of fractions.

An important point which arises is the speed at which it is advisable to run an engine. Heavy-duty engines should not be considered in the same class as the automobile type and should run at slower speed. The Reclamation Service engineers are conservative in this respect, and limit the piston speed of heavy-duty engines to from 700 to 800 ft. per minute.

New National Park Dedicated

The formal dedication of Zion National Park, Utah, created by Congress Nov. 19, 1919, as the nineteenth member of the National Park System, was carried out recently with Stephen T. Mather, director of the National Park Service, presiding. The new park is in extreme southwestern Utah and is reached from both Salt Lake City and Los Angeles by the Salt Lake Route to Lund.

A Study of Rapid Transit Station Design—Part II

Good and Bad Features in Arrangement of Platforms and Street Approaches—Dimensions and Capacities that Have Been Found Satisfactory

By Olof A. Nilsson
Designer, Transit Construction Commission
New York City

THE trend of development in station planning since rapid transit has become one of the important factors in the life of modern metropolitan cities will be apparent from a comparison of the earlier and later designs as shown in the accompanying illustrations.

Paris has a rapid transit system consisting of a number of independent two track lines, traversing the city in different directions. The first line, 6.4 miles in length, was opened for traffic in July, 1900. The lines all have loop-ends, permitting the trains to run continuously back and forth and around the loops without the use of switches and cross-overs. For the most part these lines are built underground with stations as close to the surface as the method of construction and the topographic conditions allow. The standard platform length is 246 ft. and the width (of side platforms) about 13.5 ft. Intermediate stations are generally of the side platform type, while most of the end stations have island platforms. The latter have also, in general, separate stopping places for loading and unloading, so that incoming and outgoing passengers are kept separate from train to street.

The simple arrangement of intermediate stations is indicated in Fig. 13. There is one stairway from the

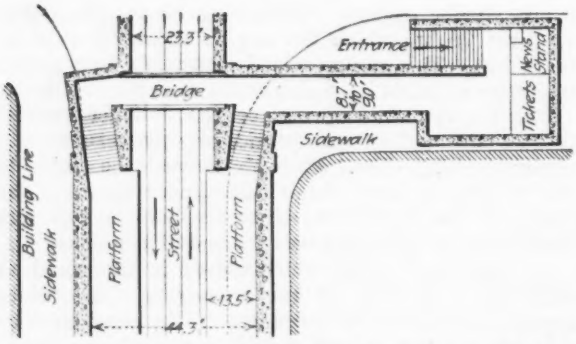


FIG. 13. TYPICAL STATION OF THE PARIS SUBWAY STATION

street, 10 to 13 ft. wide and common for both entrance and exit. This stairway leads to a lobby, where tickets are bought, and from the lobby a passageway and two stairways, all about 9 ft. wide, communicate with both platforms. Reasons of economy and a desire to avoid obstructions in the streets and public squares apparently originally determined the use of only one entrance to each station. On August 10, 1903, however, an accident took place near a station, which cost the lives of 84 passengers. This great loss of life was caused by the fact that the station lights were extinguished and the passengers were unable to find their way to the only exit of the station. After this a second entrance was built at some of the stations with heavy traffic, and other safeguards were provided to prevent the recurrence of a similar accident.

At some points, where two lines on the same level

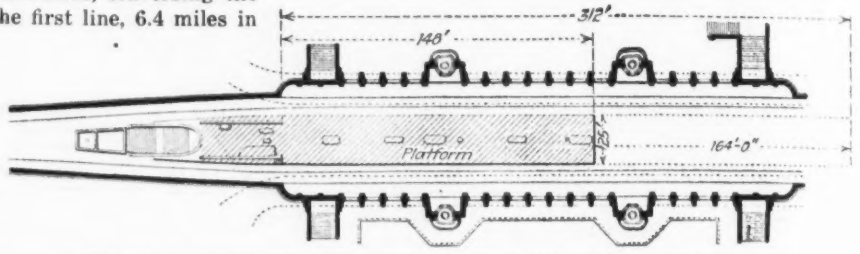


FIG. 14. A TYPE OF INTERMEDIATE STATION ON BERLIN SUBWAY

join, stations are built side by side forming a twin station with one island and two side platforms. Transfers between trains using the island platform is made direct across the platform, while passengers who land on the side platforms must make use of a mezzanine, located at one end of the platform, to effect a transfer. At other points where two lines meet—either on the same or on different levels—the stations are built separate, but near together, and communication is established and transfers made possible by means of stairways and passageways. Where three lines meet or cross there is a similar arrangement but naturally much more complicated, with greater inconvenience to transferring passengers. On this system the passenger traffic is many times as heavy as was anticipated when the plans were made, and during the busy hours of the day the platforms at the most important stations are uncomfortably crowded.

The general type of intermediate stations on one of the additions to the rapid transit system of Berlin, the Schöneberg subway, is shown in Fig. 14. This is a two track line, which was opened for traffic in December, 1910. The stations, of the island platform type, have platforms 25 ft. wide and entrances at the ends through stairways 13 ft. wide to the middle part of the street. They were planned to be built in two stages, the first part only, as shown in full lines, to be completed at the opening of traffic, the second part, shown in dotted lines, to be added when necessitated by the growth of traffic. The first part of the station with a platform length of 148 ft. accommodates a train of 3 cars; the completed station has a platform 312 ft. long and accommodates a 7-car train. The middle part of the platform is occupied by various stands and enclosures for station attendants, newspapers, etc.

Boston has a rapid transit system consisting of subways, elevated railroads and surface lines, all combined into one system with one fare and free transfers at all stations where different lines meet. The first under-

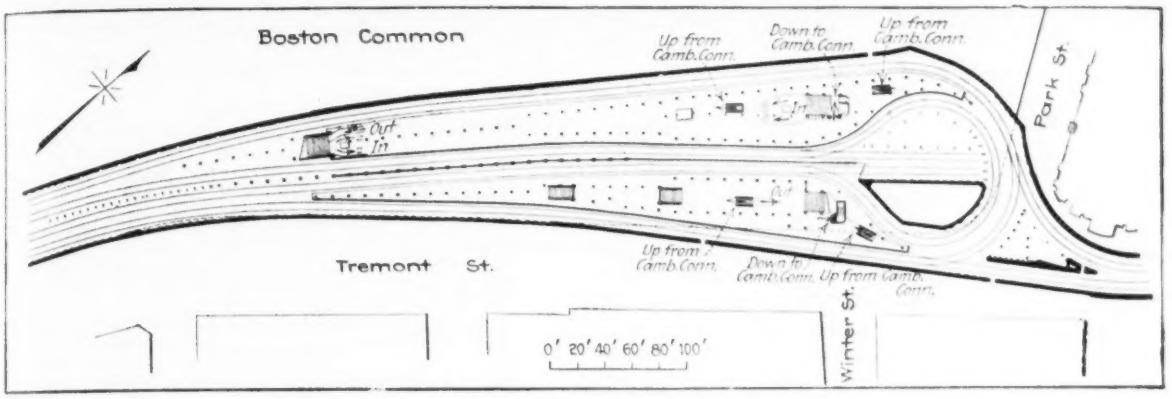


FIG. 15. PARK STREET STATION ON BOSTON SUBWAY

ground link in the system was the Tremont St. subway for surface cars, which was opened for traffic in 1897; the latest addition is the Dorchester Tunnel, which was completed to Andrew Square in 1918. The surface lines running into different cities and towns surrounding Boston are linked up with the subway and elevated lines at a number of points by transfer stations which have been designed to facilitate as much as possible the transfer of passengers between the surface and the subway or elevated lines.

The busiest station on the system, the Park St. underground station at the intersection of the Tremont St. subway and the Cambridge-Dorchester tunnel is shown in Figs. 15 and 15a. The lower level station, for Cambridge-Dorchester trains, is 350 ft. long and has two side platforms for unloading and one island platform for loading. The former are 10 to 12 ft. wide, the width of the latter varies from 18 to 30 ft. tapering from the center toward the ends. The upper level—for the Tremont St. surface cars—has two island platforms the outlines of which are indicated in the illustration Fig. 15a. Each track has berths for eight cars along the straight portion of the platform. The east platform (exclusive of stairways) contains about 9,625 sq.ft. and the westerly

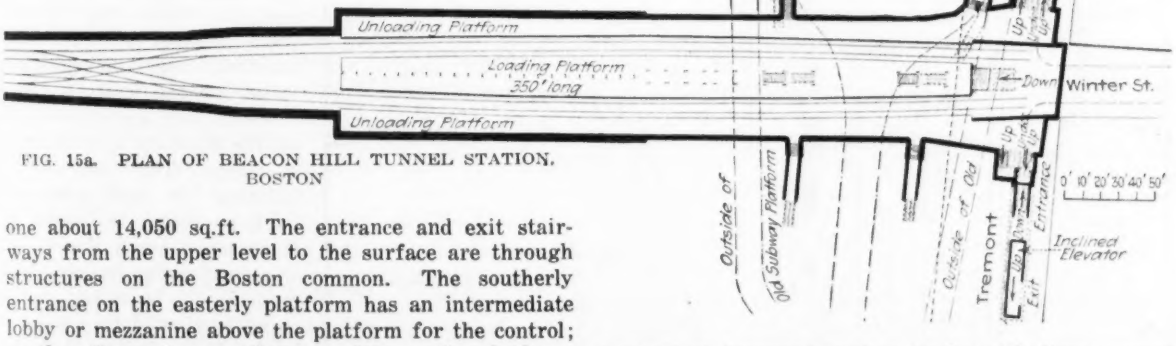


FIG. 15a. PLAN OF BEACON HILL TUNNEL STATION, BOSTON

one about 14,050 sq.ft. The entrance and exit stairways from the upper level to the surface are through structures on the Boston common. The southerly entrance on the easterly platform has an intermediate lobby or mezzanine above the platform for the control; on the other entrances the control is on the platform. The lower level has an entrance lobby at its easterly end just east of the Park St. structure with stairways to the street and from the unloading platforms, ticket control and a wide stairway to the loading platform. From both unloading platforms there are escalators to the street surface. For direct transfer between the two stations there are six stairways, one from each platform on the lower level to each one on the upper.

The Broadway transfer station on the Dorchester tunnel, Fig. 16, is built as a two level island platform station, the lower level for subway trains and the upper one for surface cars, which are here depressed below the street. Stairways in the center of the island platforms provide direct communication between the two levels. At the northerly end of the lower level platform there is an escalator to a landing just below the street surface. From this landing (connected through a ramp to the upper level or lobby platform) stairways lead to an island platform for surface cars which are not depressed. This platform is protected by a steel and wood shelter and is a prepayment station for passengers entering at this point. Thus passengers may transfer between the cars on any of the three levels.

The present terminus of the Dorchester tunnel, the Andrew station at Andrew Square, is shown in Fig. 17.

Instead of depressed surface tracks with direct connection between surface and subway cars as in the previous illustration this transfer station has the platforms for the surface cars at the street level and connection to the subway platform below is provided by a subsurface mezzanine floor. The surface station, enclosed within a one story building 115 ft. wide and 297 ft. long, has an island loading platform and two side platforms for unloading. From these three platforms stairways lead down to the mezzanine, which by passages and stairways

communicates with the subway platforms below. There is also an escalator from the southbound subway platform to the loading platform on the street level. The general passenger movement being from the unloading platforms in the surface station to the northbound subway platform and from the southbound subway platform to the loading platform on the street level, this arrangement gives escalator service to the majority of passengers transferring from subway to street level.

An extensive rapid transit system including both subways and elevated roads has been planned and is being built in Philadelphia and the stations on this system are good examples of modern, well planned, rapid transit stations. Fig. 18 shows the Girard Ave. express station on the Broad St. subway. The platform length is 550 ft., the width at the center 20 ft. 9 in. tapering toward the ends through a large radius curve on the outside platform edge. The platforms are accessible from the street through a mezzanine under Girard Ave. which has eight stairways from the street and three to each platform. In addition there are stairways for exit only, near the ends of both platforms.

A local side-platform station on the same line at Ridge Ave. has a similar arrangement with entrances and exits at the center and additional exits near the ends. The platforms, 12 ft. wide except at the ends, where the width is 10 ft., are unobstructed through their entire length, platform columns being eliminated and the stairways being built in recesses outside of the walls of the main structure. Another local station at 12th and Arch streets on the "delivery loop subway" has entrances at or near the ends with additional exits at the center.

The problem of locating entrances and exits is frequently a difficult one for the station designer. On

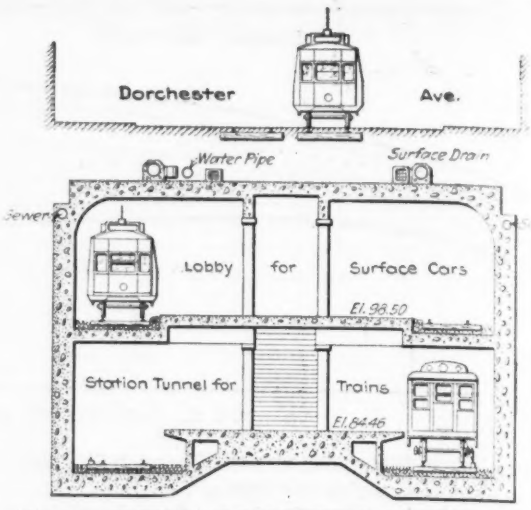


FIG. 16. SECTION OF DORCHESTER TUNNEL, BOSTON

a busy street the presence of an elevated stairway or a subway kiosk on the sidewalk is, as has been demonstrated in New York, a serious impediment to the movements of pedestrians. On the other hand a subway or elevated entrance located entirely inside the building lines of an adjacent business building, not only has the virtue of not being a sidewalk encroachment, but is also an actual asset to the owners of the building, increasing in value as the traffic increases. This has also been demonstrated in New York where property owners in general are alive to the advantage of having a subway entrance on the premises, and are quite willing to grant the space for and pay the cost of an entrance without any other compensation than the resulting increment in rental value. In the building of the Frankford elevated railroad, it was aimed to avoid placing the station stairs on the sidewalks. At all stations on this line, a building containing the stairways, controls, toilets and waiting room has been built within the building lines on property taken for the purpose under condemnation proceedings. At the platform level there is a bridge from the station building to the platform. Such a station is located at Ruan and Church streets. It is a rectangular building and control may be either at the street level or at the platform level. It is obvious that the advantage of an unobstructed sidewalk is not the only one that may be secured by this method of building elevated stations. Rental space at a point passed twice daily by thousands of passengers is extremely valuable for certain businesses and by placing con-

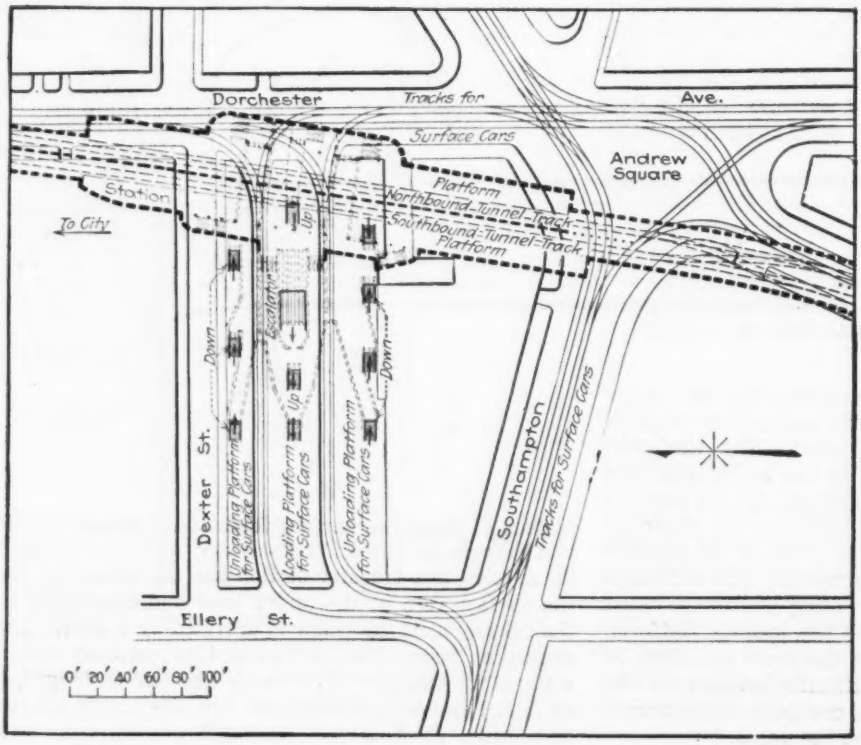


FIG. 17. ANDREW SQUARE STATION, DORCHESTER TUNNEL, BOSTON

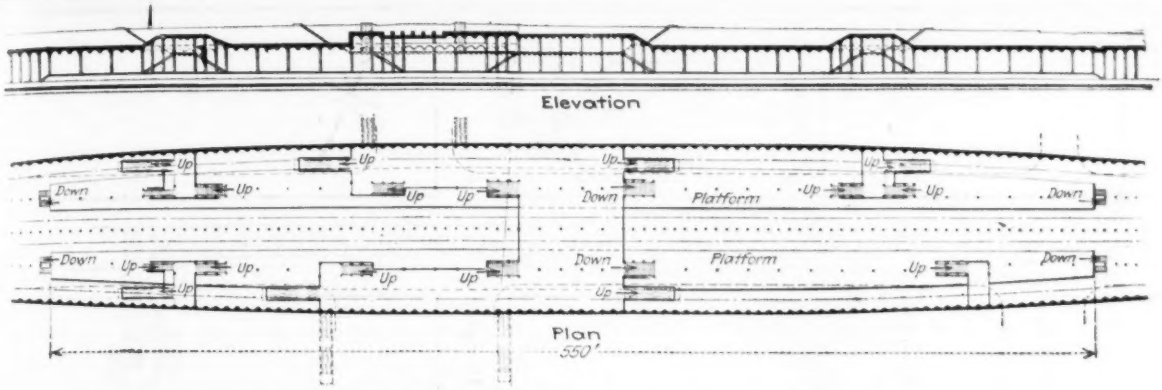


FIG. 18. GIRARD AVENUE SUBWAY STATION, PHILADELPHIA

trol, toilets and waiting rooms at the platform level, occupying on the ground floor only as much space as is needed for stairways and entrances, it should be possible to secure a very considerable rental for the remainder of the ground floor area. It is, indeed, entirely reasonable to assume that in many cases, the loss of income from the portion of the lot required for station purposes, would be more than offset by the increased yield due to the presence of the station from the remaining portion.

New York has a greater mileage of rapid transit railroads than any other city in the world. When the dual system, as planned at present, is completed it will comprise about 225 miles of subway and elevated lines and will have a total of 620 miles of single track. In addition to the dual system New York has the Hudson & Manhattan railroad, the Westchester railroad and the suburban lines of the steam railroad systems that enter the City. On the dual system there are about 400 stations including many different types.

The Brooklyn Bridge station of the first subway in New York, opened for traffic in 1904, is shown in Fig. 19. This station, the same as the other express station on the original subway, was built for 8-car express trains with platforms about 350 ft. long. The width of the express platform at the center is 20 ft., narrowing toward the ends. The stairways from the platforms are 8 ft. wide and the mezzanine platform or bridge spanning the tracks is 20 ft. wide. The two side platforms of the station have never been used. When the rapidly growing traffic made the train service originally adopted insufficient, the express platforms were lengthened to 480 ft. and ten-car express trains put in service. A ten-car train is 520 ft. long so that the end doors of the first and last cars do not come within the platforms and are not used. The full lines show the station as originally built and the dotted lines the express platforms as lengthened.

The Chambers St. station of the 7th Ave. subway opened in 1918, is shown in Fig. 20. It is located not far from the Brooklyn Bridge station and invites a comparison with the latter. The platforms are 18.5 ft. wide and 485 ft. long. Instead of a narrow bridge spanning the tracks we find a large mezzanine floor under the intersection of Greenwich and Chambers streets with stairways to the four street corners. From each platform there are four stairways to the mezzanine. Should additional stairways and mezzanine area be

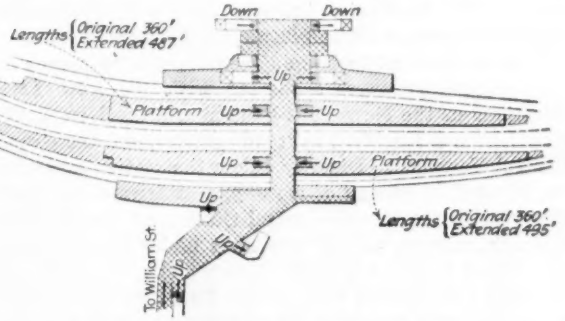


FIG. 19. BROOKLYN BRIDGE STATION, NEW YORK SUBWAY

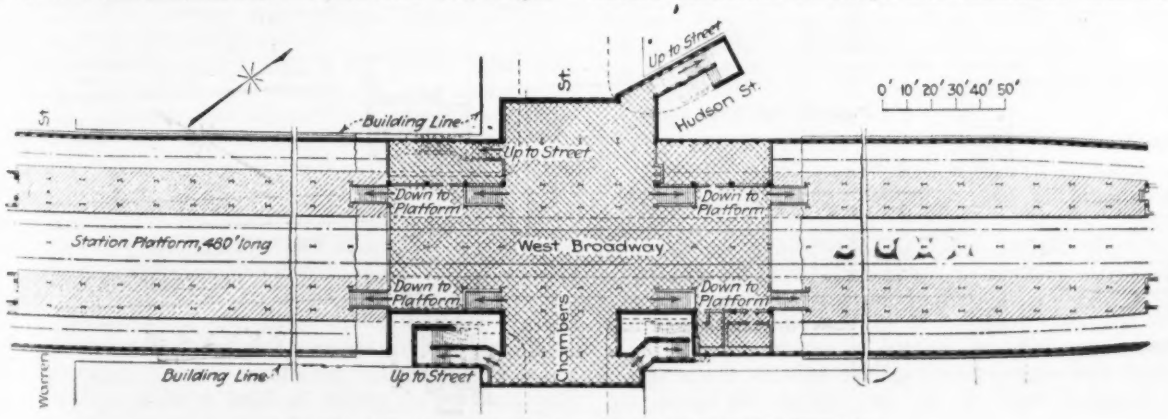


FIG. 20. CHAMBERS STREET STATION, NEW YORK SUBWAY

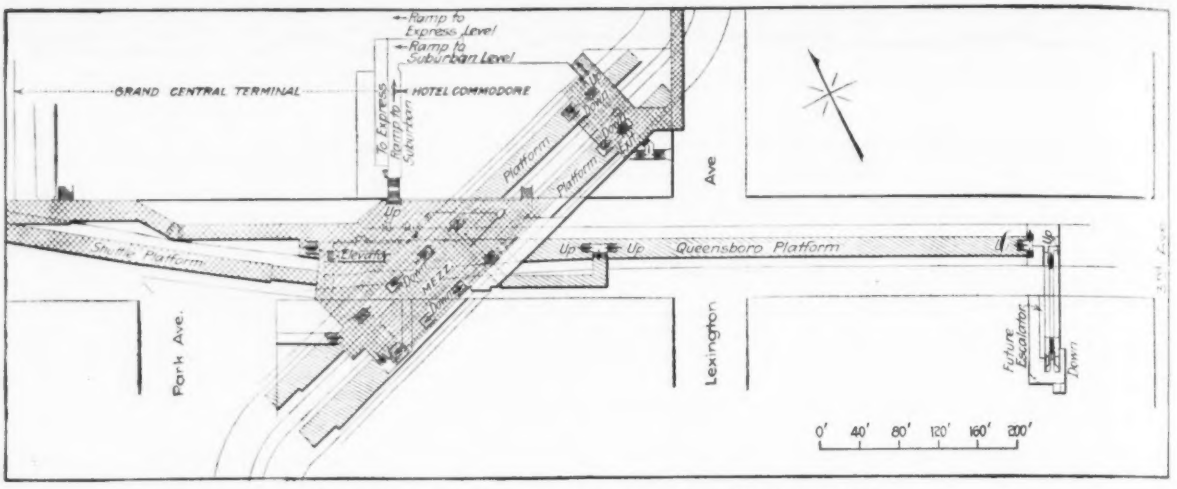


FIG. 21. GRAND CENTRAL SUBWAY STATION, NEW YORK

required the mezzanine can be extended over the platform in both directions.

A station that by virtue of its location is destined to have a very heavy traffic is the Grand Central station of the Park Ave.-Lexington Ave. subway (Fig. 21) opened for traffic in August, 1918. It is located diagonally across Forty-second St. between Park and Lexington Avenue, and is adjacent to and by means of underground passages connected with the New York Terminus of the New York Central and the New York, New Haven & Hartford railroad systems, and the Grand Central Terminal. Directly below the station and connected to it by means of a ramp, a stairway and three elevators is the Grand Central Station of the Queensborough subway, which here runs under Forty-second St. There is also a shuttle service under Forty-second St. from this station west to the Times Square station on the Seventh Ave. line. It is evident that in addition to the traffic originating in the neighborhood, rapidly being built up with large office structures and hotels, an unusually large transfer traffic will result from the meeting and intersection of these traffic lines.

The main outline of the station, Fig. 21, shows it to be of the ordinary type for four-track express stations with two island platforms of varying width about 485 ft. long. Each platform has, in addition to two stairways leading down to the passageway and ramp communicating with the Queensborough station below, six stairways leading to two mezzanine floors above the platform. From these mezzanine floors there are numerous passages and stairways leading through adjacent buildings to the street level and opening on Forty-second St., on Park and Lexington Aves., and as far north as Forty-fifth St. A short ramp connects the larger of the two mezzanine floors with an island platform serving the shuttle trains to the Times Square station.

It would be easy to have ideal rapid transit if cities were planned and built to order with the laying out of a subway system as the first step in such building. It is a different problem to supply means of rapid transit in a metropolis, which is a growth of generations or centuries. The streets, lined with tall buildings, are narrow and crooked where width and straight lines are needed for stations and the space under the street surface required for the latter is already taken up by the different structures that form the organs of supply and evacuation and of transmission of intelligence by which the life of the city is carried on. Fig. 22 shows a station built under such conditions, the Wall St. Station on the William St. line. The street is at that point only 38 ft. wide and has a slight bend. The station is there-

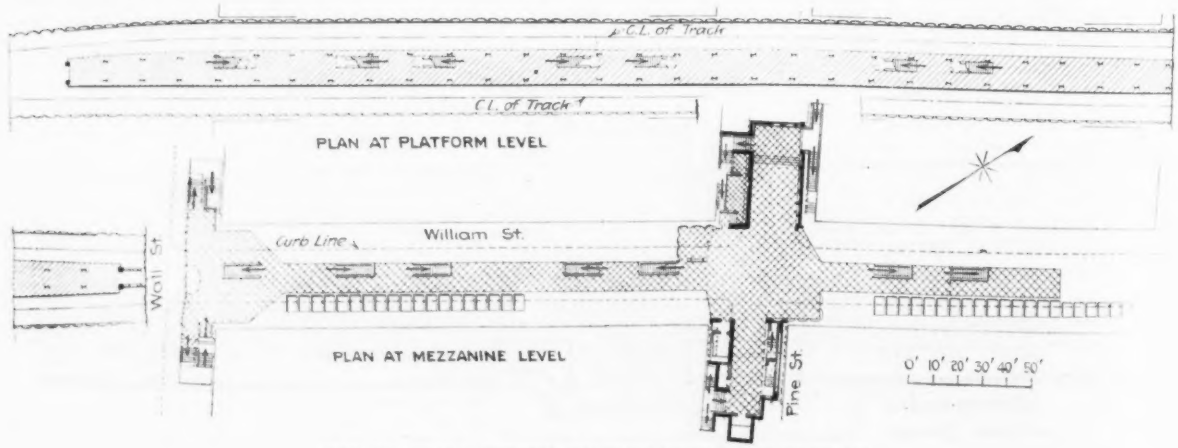


FIG. 22. WALL STREET STATION, NEW YORK SUBWAY

for on a curve (although of such large radius that it is no disadvantage) and the platform width varies from about 12 ft. at one end to a maximum of 14 ft. at the center. There are seven stairways between the platform and the mezzanine floor above and from the mezzanine there are stairways to the surface on Pine and Wall streets.

The examples of rapid transit stations here illustrated have been built to suit widely different conditions in traffic volume and in other respects. A comparison of the size of stations built 20 or 25 years ago with those of today gives a striking illustration of the growth of rapid transit during this period. On the first New York subway the platforms were originally planned for a length of 200 ft. on local and 350 ft. on express stations (this applies only to the island platforms) serving respectively five- and eight-car trains. It was not long, however, before it became necessary to lengthen the express station so that ten-car trains could be used, and lengthening of the platforms of the local stations is now under consideration. On the Centre Street Loop, which was the next line to be built, the platforms were made 435 ft. long and on the Fourth Avenue subway in Brooklyn the express and local stations were made 480 and 435 ft. long respectively.

Since the dual system contracts were executed in 1913, no station on the Interborough system has been built less than 480 ft. in length and on the New York Municipal lines the latest stations have been made 530 ft. long, accommodating trains of eight 67-ft. cars. The length of express platforms on the rapid transit system in Sidney, New South Wales is 520 ft. and on the Philadelphia system it is 550 ft.

It is not necessary to repeat that the arrangement shown in Fig. 13 is a bad one. For a station of this length—about 250 ft.—one point of ingress and egress would be sufficient if placed at the center of the station, but if placed at one end there should be at least an exit at the opposite end.

On a two-track line an island platform station of the type shown in Fig. 14 is both economical in operation and convenient for passengers. Where conditions permit the placing of the entrance in the longitudinal axis of the platform and where the station length and traffic volume are such that an entrance at each end is sufficient, a mezzanine can be avoided and the station built close to the street surface.

The stations shown from the Boston rapid transit system are of a special type—transfer stations between surface cars and subways.

The Girard Avenue station of the Broad Street subway in Philadelphia, shown in Fig. 18, has platforms 550 ft. long and 20 ft. 9 in. wide at the centre and six stairways from each platform with a total width of 37 ft. The corresponding figures for the Chambers Street station in the New York subway, Fig. 20, are, length 480 ft., width 18 ft. and four stairways, totaling in width 27 ft. The mezzanine of the New York station has a gross area of about 10,000 sq.ft. with four entrances, all located near Chambers Street, on which the station is centered. The mezzanine of the Philadelphia station is about 8,000 sq.ft. gross area and connects with the street by 8 stairways. The two additional exits near each end of the station make a total of twelve connections with the street, four on Girard Avenue, one on Stiles Street and seven located at different points along Broad Street.

In conclusion it may be pointed out that the differences in station design which a comparison of rapid transit systems in different cities and countries discloses are partly the result of and are based on the experience gained under differing local conditions. Among these differing conditions are: The city plan and streets, the habits and customs of the people as to travel, operating methods, etc. What may be adopted for good reasons and after careful investigations in one place may be rejected for equally good reasons in another. The station planner, therefore, as in all other engineering work, while learning from the experience of others, must above all begin by analyzing the conditions of his own special problem.

Resurfacing Flexible Pavement

By H. T. Macfarland
Barber Asphalt Paving Co., Philadelphia, Pa.

IN RESURFACING a section of Broad Street one of the heaviest traffic streets in Charleston, W. Va., during the early part of this year, the fact was brought to light that the original brick pavement had been laid over boards. To meet this condition, which imparted to the pavement unusual flexibility, it was necessary to adopt exceptional construction methods.

Broad street, from Quarrier St. to Smith St., was paved with brick in 1894, and from Virginia St., to Quarrier St., in 1899. Investigation showed that after the grading was completed, 2 in. of sand had been spread, on which had been laid 2-in. planks which had been dipped in tar. Over the boards 2 in. additional of sand had been placed, and on this base the brick had been laid.

Despite the fact that they had been down for 21 and 26 years, the boards were in good shape, but when exposed to the air for a few days they began to weather. The subsoil was so firmly compacted that it was difficult to break it with the heel. In some places it was found that the sand both under and over the planks had shifted, and upon advice the contractor removed the brick in such places, and added sufficient sand to bring the surface up to grade.

Several sections were in bad shape, and at these points the old brick, sand and boards were removed. Fresh sand and new planks were placed, then new brick were laid and the section thoroughly rolled. No concrete or other rigid type patches were made, because of the flexibility of the old pavement. It was feared that the impact of heavy trucks as they struck the patched spots, and as they skipped from the nonflexible to the flexible sections would seriously damage the pavement. All minor depressions were brought to grade by the addition of extra binder.

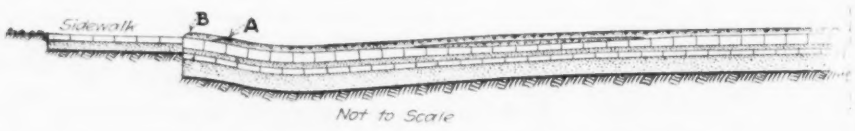
The surface mixture was composed of Cold River sand, coarse sand, Lake Erie sand, fine sand, limestone dust and 12 per cent asphalt, gaged by bituminous content. To complete the work required about thirty-five more tons of Trinidad Lake asphalt than the contractor had figured upon for binder and top. The extra material was used to give the resilence essential because of the flexibility of the foundation, and also to provide an excess of asphalt, so that any cracks which might develop during the cooler periods might heal under the summer sun. G. T. Fogle & Co., were the contractors.

Old Brick Pavement Resurfaced With Asphaltic Concrete

Deep Depressions Concrete Filled—Uneven Cross-Section Leads to Payment on Both Square and Cubic Yard Basis

By Roy M. Green
President, Western Laboratories, Lincoln
and John L. Hershey
Special Engineer, Beatrice, Nebraska

MANY cities are now confronted with the problem of how best to utilize their old brick pavements after their surfaces have become rough and worn by years of traffic. Such a condition has been met and overcome in Beatrice, Neb., by resurfacing them with either a sheet asphalt or an asphaltic concrete mixture laid directly on top of the old pavement. A number of streets have been resurfaced in this manner during the past few years but the most recent work has been that of resurfacing West Court Street with an asphaltic concrete wearing surface.



TYPICAL CROSS-SECTION OF RESURFACED STREET

The old pavement cross section, shown in the accompanying figure, was laid with a crown of 8 in. in a width of 43 ft. between gutters. When this pavement was originally constructed the subgrade was finished and rolled and a 6-in. sand base laid directly upon it. On top of this sand base was laid a foundation course of brick, laid flat. A 2-in. sand cushion was then spread over the brick foundation and the brick wearing surface was set directly upon this cushion. The bricks used for this work were 2¼ x 4 x 8 in. in size. The bricks in the wearing surface were set on edge. Sand was used to fill the joints.

Since an abandoned street car track was located in the center of the street, the traffic had always stayed away from the center of the pavement and traveled along the quarter points. Traffic had, in this way, worn the quarters until they were from 1½ to 2 in. low. There were, also, depressions from various other causes such as settlements caused by street openings and worn bricks which had caused pot holes. In fact the street had been very rough for several years and traffic had avoided it as much as possible.

The uneven surface of the old pavement and the worn condition of the bricks along the quarter points produced such an irregular base that considerable work was necessary to produce a more regular section before the surface of asphaltic concrete could be applied. This was necessary in order that a suitable cross section could be obtained for the finished surface, otherwise the irregularities in the base were certain to be apparent at the surface.

In doing this work the deep depressions were repaired by taking up the bricks in the top course, removing the sand cushion and filling these openings with portland cement concrete laid on top of the foundation course of brick. The pavement was then thoroughly cleaned by flushing and the local depressions and the depressions along the quarter points were filled with a binder mixture of Joplin flint chatts and asphalt cement. This produced a working base which, however, was not accurate enough to make it possible to lay a uniform thickness of 2 in. of wearing surface mixture and obtain the proper finished cross section.

The old brick gutters were so irregular that they did not drain in many places. For this reason it was impossible to use the old brick as a gutter without topping it. Also, the edge of the asphalt surface would have been subjected to a great deal of wear had it been laid only to the inside edge of the brick gutter since it would have been necessary to make a feather edge at that place. Further, any high water in the gutter would have easily penetrated beneath the asphalt surface at the edge. The asphalt surface was, therefore, carried across the gutter. On the west end, where the grade of the street was sufficient to carry the drainage without covering the shoulder to the sidewalk line the surface was carried only to *A*. (See cross-section.) In other places it was carried up to the sidewalk *B*. In the former case the old brick at the edge was heavily squeegeed with asphalt cement so that the entire street now has the appearance of being completely covered with the asphalt wearing surface. Due to the irregularities of the base it was impossible to adhere to a thickness of 2 in. of wearing surface, as a much greater thickness was required in many places. Unit bids were, therefore, received on the 2-in. wearing surface on a square yard basis, and also bids on binder on a cubic yard basis. Accurate records were kept of the weight of all the surfacing material and binder used in the work. The contractor was paid his unit price of $1.50 per square yard for all the surface laid. The weight of the 2-in. surfacing was then deducted from the total amount of mixture used and the difference was paid for as binder at a rate of $15 per cubic yard. This gave an equitable method of payment for the work, which protected both the contractor and the city.

The surface mixture of asphaltic concrete was designed for the heavy traffic to which this street is subjected. The mixture was made of fine Platte River blow sand, Joplin flint chatts, and limestone dust mixed with asphalt cement, analyses of the mixture being made daily, and a typical analysis showing the following composition.

	Percentage
Bitumen	7 96
Aggregate:	
Passing 200 sieve	6 2
Passing 80 sieve on 200 sieve	13 5
Passing 40 sieve on 80 sieve	14 0
Passing 10 sieve on 40 sieve	16 3
Passing ½ screen on 10 sieve	24.7
Passing ½ screen on ¼ screen	17 3

As a result of this work Court Street has been changed from a very rough and undesirable street to a smooth and perfectly satisfactory street at a very low cost to the city. The work was done by the Abel Construction Co., of Lincoln, Nebraska, under the supervision of John L. Hershey, Special Engineer, Beatrice, Neb., and Clark E. Mickey, Consulting and Testing Engineer, Lincoln, Neb.

Notes from Foreign Fields

TROUBLES AND JOYS OF A TRAVELER—HOMEWARD BOUND

By E. J. Mehren
Editor, *Engineering News-Record*

IT SEEMS fitting in closing this series of notes that I should indicate some of the ways in which travel in Europe differs from what it was before the war, and that I should also pay my respects to those who have helped me in studying the engineering situation here—studies that have been interpreted in an impressionistic way in these notes.

After a circuit of the western countries of the Continent I am again in London, homeward bound. With a few days here to wind up some unfinished business, but without rush, I can look back at three and a half strenuous months and begin to make an appraisal of their results. There has been much of pleasure, much of satisfaction, and just enough annoyance and inconvenience to throw the pleasant part of the journey in relief. Of the pleasant experiences I have said much. Possibly I may be allowed the indulgence of relating a few of the troubles, particularly since, in the present unsettled state of Europe, they are likely to be of interest to people in the States.

SIR HENRY MAYBURY, K.C.M.G., C.B.,
Director General of Roads,
Ministry of Transport, United Kingdom

Finally, it would not be fitting to close these notes without a word of thanks to those who have facilitated my work.

Passports and Visés—Outstanding among the annoyances which the traveler experiences in Europe today is that of the passport. This is an evil inheritance of the war. It is a minor one, it is true, but after one has stood in line for many an hour, at frontier stations and at visé offices, he is apt to chafe under it. Whether its continuance is warranted it hardly befits an American to say. Certainly, there is much radical propaganda in Europe, and the passport system may help to keep fomenters in their home lands. In any event, the system is here and must be endured.

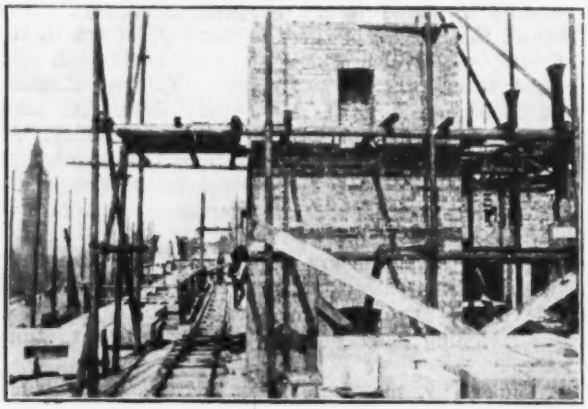
As is well known, the traveler must get a passport from his own Government and must have it viséd by a passport or consular official of every country that he proposes to enter. These passports are always examined at the frontier. There is much difference in the efficiency with which examinations are made, both with respect to customs and the passport. Entering England and Belgium the work was quickly done. At some Continental points, however, there was great delay. As a rule, if one passes by train from one country to another, it is necessary at two points, close together, one on either side of the international border, to remove all of the luggage from the train and have it inspected. Passports are examined at the same time. Necessarily the passengers must stand in line and wait their turns—not a welcome incident at the end of a long fatiguing journey in midsummer in a hot, stuffy room.

Temporarily, too, there is an additional annoyance, in the limitation of the amount of money one may take out of certain countries. For example, at the time I left France one could take out currency, no matter of what country, to the total value of only 1,000 francs. The limit on silver was 10 francs, while the exportation of gold was prohibited entirely.

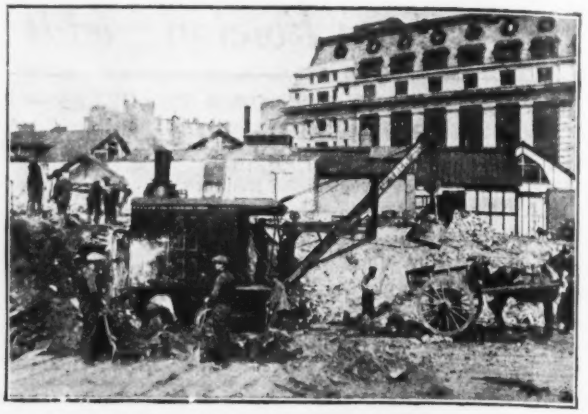
DR. J. H. T. TUDSBERY
Secretary,
Institution of Civil Engineers, London

At Bellegarde, on the way to Switzerland, the various frontier formalities caused a delay of 1 hr. 20 min., during which the passports were examined four times, the passengers quizzed twice (very sharply regarding the amount of money in their possession), and the baggage searched with rather more thoroughness than is customary, with a view to the discovery of hidden gold, silver, and bank notes. Arrived in Geneva, about an hour after leaving Bellegarde, there were, necessarily, the Swiss examinations. They were made with fair expedition, but the annoyances at Bellegarde are such that previous travelers had unburdened themselves, while waiting at the final barrier in Geneva, by scribbling their thoughts on the unpainted pine-board partitions. An Englishman had written, "The last barrier to freedom"; an Italian, "Ye who enter here leave all hope behind," while an Argentinian had described the formalities as "Two hours in Purgatory."

The passage from France to Switzerland, I must admit, was annoying, but it was duplicated in going from Germany to Holland, via Bentheim-Oldenzaal. Here the examination was more thorough, and if the passenger was unfortunate enough to have silver, he was mulcted out of it at the German station, Bentheim.



ROUND SCAFFOLDING TIMBERS ON LONDON BUILDING



AMERICAN STEAM SHOVEL IN HEART OF LONDON

At the left of the first illustration may be seen the clock tower of the House of Parliament—the steam shovel in the other picture is excavating the foundation of Bush House, on the Strand, being built by Irving T. Bush, of New York, as a sales center, similar to his sales center on West 42d St., New York City.

In fact, I experienced at Bentheim the only real injustice of my entire trip. Though I had but 2½ guldens, it grates yet, particularly because I have met a fellow-American here in London who had an experience similar to mine, thus assuring me that my case was not peculiar. He had about 10 guldens in silver. I had bought the Dutch silver the day before in Berlin, being ignorant of the fact that no silver whatsoever may be taken out of Germany. At Bentheim I was informed that it could not be taken out. Upon inquiring as to what could be done with them I was referred to an adjacent inclosure, and there calmly informed that, though the 2½ guildens had the day before cost 37½ marks they would give me only 20 marks for them. Protests were of no avail and there was nothing to do but accept the 20 marks. As a further evidence of the unfairness of the procedure they refused to give one a 2½-gulden note in exchange for the silver pieces. In other words, they had the travelers at their mercy and robbed them—robbed them with official sanction, since German officials stood alongside the cage and shrugged their shoulders at the travelers' protests. The banking booth had on it a sign, "Barmer Bank Verein, Hinsberg, Fischer & Co." I have since made inquiry as to the standing of the Barmer Bank Verein and learn that it is a strong institution, with a high standing. Evidently, however, it is placing no check upon its agents—Hinsberg, Fischer & Co.—and does not realize that they are forever discrediting the name of the Barmer Bank Verein with those who fall into their hands. At the time I passed through Bentheim they were, by paying 20 marks for silver pieces that were selling in Berlin for 37½ marks each, making a profit of 87½ per cent.

It is needless to say that travelers imposed upon believe that the robbery was due to connivance between the agents of the Barmer Bank Verein and petty German officials, and that the matter would be promptly stopped if it could be brought to the attention of the proper officials in Berlin.

But to return to the visé. As a rule an American finds little difficulty in getting a visé—other than the annoyance of waiting in an anteroom for two or three hours in order to get to the proper official. However, one does strike a snag in case he desires to go into Bavaria, one of the states of the German Empire.

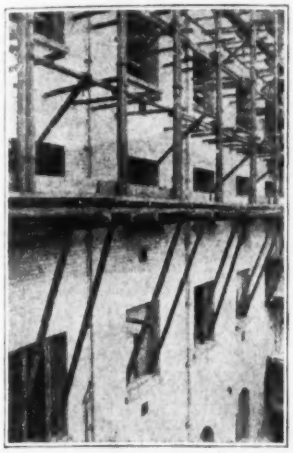
It appears that in 1919 the report gained currency in Prussia and other parts of Central Europe that Bavaria was better supplied with food than its neighbors. Consequently there was a great rush of visitors, with the result of a rapid consumption of the really limited Bavarian food supply. To prevent a repetition the Bavarian Government decided that no one would be allowed to cross the frontier without securing in advance a police permit from Munich. These permits are issued only for good reasons, the prospect of opening business relations in Bavaria being, as a rule, not sufficient to secure permission to enter.

In London I had taken the precaution of calling at the German Consulate and presenting my papers to learn whether there would be any difficulty in securing a permit to enter. I was told that there would be no difficulty. Apparently, however, I failed to make clear that I desired to go not merely to Prussia, but to Bavaria as well. Upon reaching Berne the German officials informed me that they would be unable to give me a visé to go to Munich, though they would at once visé my passport to go to any other part of Germany. The officials at Berne were most gracious and wired the proper ministry in Berlin, explaining the case and urging that my Berlin references be looked up, and if found satisfactory that efforts be made to secure for me the necessary permission to go to Munich. The routine in Berlin caused delay and after three or four days of waiting I tried independently, through connections in Munich, to get the coveted police permit, and in that proved successful. In all, there was a week's delay.

Even though one recognizes the reasonableness of restrictions, one cannot help but feel uneasy and annoyed at the loss of time. I felt in that mood myself, until, calling at the American Consulate in Zurich, I heard a colloquy between the official in charge and a young German business man who desired to secure a visé in order to visit the United States. He was told that it would take four months to get the visé if the matter were handled by mail, but that it could be done in five to six weeks by cable, at a cost to himself of about 100 francs. He had no letters from the United States, but wanted to study American conditions, with the idea of establishing business connections there. After hearing the colloquy I not merely felt thankful that my delay had been no longer than a week, but marveled that the Germans should admit us so freely when we place such

barriers in the way of their visiting the United States. The arrangements seem hardly to be reciprocal.

Of all the annoying visé offices I visited that of the American Commission in Berlin was the worst. Both Americans and Europeans complained about it. Not even the simple expedient of giving numbers to applicants as they came in—a universal practice in visé offices—was in vogue. Everybody crowded around the counter and made efforts regardless of time of arrival to attract the attention of the single clerk who was trying to take care of a large crowd.



ANOTHER VIEW SHOWING ROUND SCAFFOLDING TIMBERS

Before sailing for Europe I was warned that I could expect great inconvenience in traveling accommodations. Such, however, did not prove to be the case. Apparently there was a material difference between conditions in 1919 and 1920. It is true that there were fewer trains than before the war; on the long runs there are now, as a rule, only two trains a day, one leaving in the morning and one in the evening. The trains are slower than they were before, but, except in the third class, the accommodations are ample, while on all of the long day runs dining cars are carried. While one lacked on the Continent the ease and comfort that are found on American and English railroads, the conditions are not such as should discourage travel.

Acknowledgment of Courtesies

But if one must put up with inconvenience, there is more than ample compensation in the pleasant hours one spends among European scenes and in the company of cultured Europeans. My time was spent, as was to be expected, largely with engineers, and I found that the bond which binds us together in the United States has international strength as well. The mere fact that I was an engineer was a sufficient introduction everywhere. Not only did each individual make accessible to me the information at his command, but offered suggestions as to other sources of information. Such suggestions frequently materialized in letters of introduction which passed me on from one engineer to the other, until my wishes in the particular direction were gratified.

To acknowledge by name all of those to whom I was indebted would exceed the reasonable bounds of space. I will be pardoned, though, if I put down the names of a few whose courtesies were of an unusual order: M. Paul Le Gavrian, ingenieur en chef des ponts et Chaussées, in Paris; Prof. A. Rhon of the Zurich Polytechnicum; Dr. Ing. Oskar von Miller, Munich; Prof. C. Matschoss, of the Verein Deutscher Ingenieure, in Berlin; Heer G. J. van den Broek, engineer of the North Sea Canal, Amsterdam, and Mr. J. S. Killick, chief engineer of the roads department of the Ministry of Transport, London.

Two other gentlemen I have left for special mention, not merely because of the assistance rendered to me, but because they and their work are so well known in the United States; I refer to Sir Henry Maybury, K.C.M.G., C.B., director-general of roads, Ministry of Transport, London, and Dr. J. H. T. Tudsbery, secretary of the Institution of Civil Engineers, London.

As those who know him would expect, Sir Henry bears his dignities and his heavy responsibilities well. Backed by a long professional experience, in railroad work, in public-works construction, and in the manageemnt of municipal works (as engineer, surveyor, and general manager of important local boards and district and county councils), he came to the position of chief engineer of the Road Board in 1913, richly endowed for the work. During the war he became director of roads in France, responsible for the maintenance of some 4,000 miles of highway, of vital importance in the transportation of troops and supplies to the firing line. Some 330 officers and 13,600 men, all skilled road and quarry troops, were under his command, while, in addition, unskilled detachments to a total of 30,000 men were almost constantly under his direction. In recognition of his great service, he was knighted at the close of the war. Upon the formation of the Ministry of Transport he was made director-general of roads, and has recently been honored by election to the vice-presidency of the Institute of Transport, a new organization formed to further the interests of transport generally, whether by water, road or rail. Under his guidance the road work of the United Kingdom is receiving that careful consideration demanded by the very rapid increase in the number and weight of motor vehicles. He commands the confidence, as I found everywhere, of the road engineers and surveyors of the United Kingdom. They recognize in him a worthy leader—an engineer of high professional attainments, a man of sincerity, purpose and ability, with a character and personality that have commanded universal admiration.

Dr. Tudsbery carries well his sixty-one years. He would be taken for a much younger man. His secretaryship of the institution dates back to 1896. During the period of his executive administration he has seen the great institution grow and broaden, go from one fine house to a greater one, in order to meet its needs making more secure year after year its place as the leader among engineering societies. I found him affable and desirous of doing everything he could to smooth my way. He spoke charmingly of his American friends and showed a very great interest in what we are doing on our side of the water. He sees larger opportunities for the functioning of the institution and enlarged upon the plans now under consideration, which were reported in these notes some months back.

Help from Home.—In paying a tribute to the engineers in Europe who helped me, I must not forget that my way was much smoothed by letters that I brought from our side. Not only did those letters help me, but I was constantly under obligations to American engineers for what they had previously done for Europeans visiting in America. More than once when I protested at the fullness of courtesies being extended my host would rejoin that he was merely trying to repay, through the medium of my humble self, some of the debts of hospitality that he himself had contracted when visiting America.

All of which goes again to emphasize what I said

before, that the fellowship of engineering is international. The bonds can be much strengthened by an interchange of experiences such as is involved in a foreign trip. Though we may not always see the connection and though the war may make us doubt as to the value of any attempts at international amity, I do believe that we engineers in our intercourse with our fellows in other lands are playing a part in the great international drama of trying to get the nations to live and work harmoniously with each other.

While my mission has, I hope, had some effect in this direction, it was, of course, essentially journalistic—an effort not merely, through these notes, to lay some thoughts on European engineering developments and European engineering thinking before the readers of *Engineering News-Record* but to arrange by the renewal of our connections abroad (connections disturbed by the war) for a flow to our readers of what is best in engineering work in Great Britain and on the Continent. As to the flow of material, time must be the test, but I have high hopes that my mission will result in giving American engineers a near or a bird's-eye view, as the particular conditions warrant, of the best in European engineering thinking.

London, Aug. 12, 1920.

(This article concludes Mr. Mehren's notes on his European trip.—EDITOR.)

Heavy Spans To Be Rolled and Jacked in Difficult Bridge Reconstruction

New Double-Track Structure of Increased Load Capacity Provides Wider Channel Openings and Greater Clearance Height—Erection Under Traffic—Will Shift Track to Higher Elevation in One Day

RECONSTRUCTION of the Allegheny River crossing of the Baltimore & Ohio R. R. at 33rd St., Pittsburgh, Pa., which has been actively under way during the present season and is now nearing completion, represents a series of replacement operations of exceptional complexity and difficulty. The renewal of the bridge was necessary not only to provide capacity for modern loading, but also to adapt the crossing to the new requirements of the War Department with respect to channel widths and navigation clearance. The latter requirement involved new pier locations, longer spans, and a higher elevation of the structure. Under these circumstances the replacement of the old structure with a new one on the same alignment became highly complicated.

The Allegheny River bridge, forming part of the Pittsburgh Junction R. R. of the Baltimore & Ohio system, is perhaps the most important structure on the latter's line between New York and Chicago, and is the limiting structure from the standpoint of motive power. The old bridge, designed by Theodore Cooper, was completed in 1884. Its river portion consisted of four through-truss double-track spans varying in length from 167 to 250 ft. It was necessary that the new structure be so designed as to give a 400-ft. channel, which, in view of the 75° skew, demanded a channel span of 436 ft. 9 in. center to center of piers. The outlines of both old and new bridges are given by Fig. 1. The new structure is designed for double-track E60 loading.

Several years ago the approach to the bridge on the line of 33rd St., Pittsburgh, was reconstructed, the new viaduct being designed for E60 loading and so detailed as to be capable of having its grade reduced from 1.5 per cent to 0.3 per cent, descending westward, with a view to raising the elevation of base of rail 12 ft. at the east bank of the Allegheny River. This was in preparation for the subsequent reconstruction of the river crossing at higher level in accordance with the

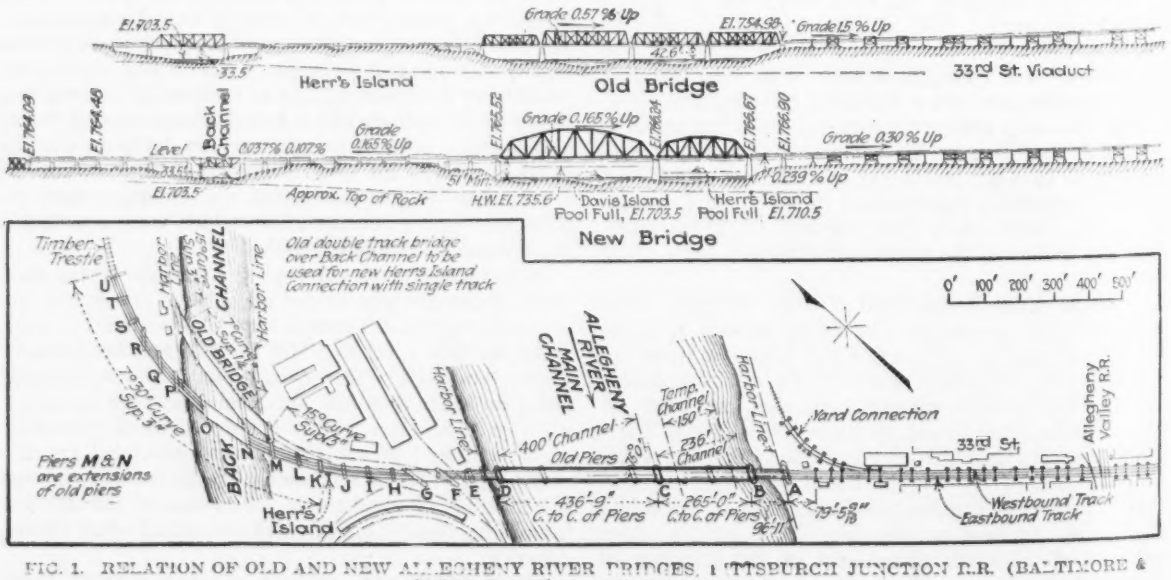


FIG. 1. RELATION OF OLD AND NEW ALLEGHENY RIVER BRIDGES, PITTSBURGH JUNCTION R.R. (BALTIMORE & OHIO R.R.) AT 33RD ST., PITTSBURGH

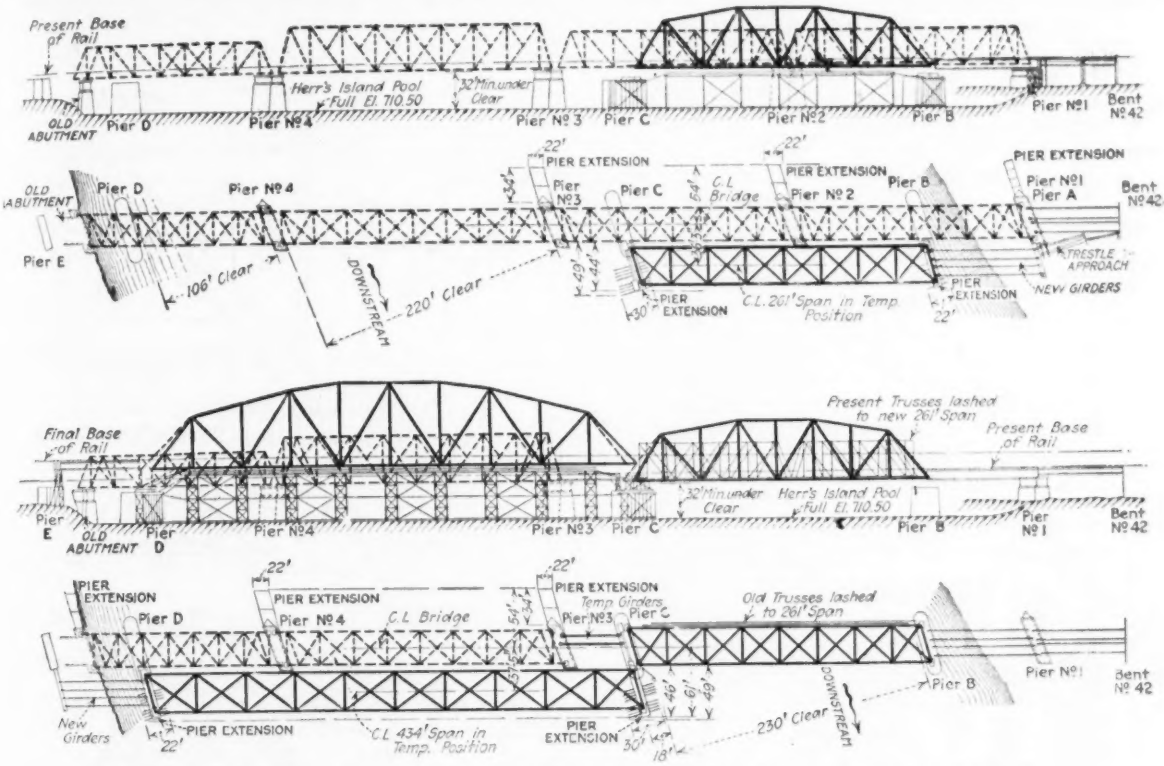


FIG. 2. CHARACTERISTIC STAGES OF ERECTION AND REPLACEMENT OF 33RD ST. BRIDGE

final decision of the government authorities in the matter of the navigation clearances to be provided at the various structures spanning the river.

The new bridge comprises two truss spans over the river, one 261 ft. and the other 434 ft. in length center to center of end bearings, a 147-ft. deck truss over the back channel, and a series of girder spans, so that the structure has a total length of 2,122 ft. The line of the new structure diverges from that of the old in its westerly portion, near the back channel, and here the old structure will be retained and adapted to single-track operation. This involves the placing of a new floor system in the present truss span over the back channel. The altered structure will be capable of carrying E50 loading.

Erection was begun in June, 1920, the work being started at both ends of the bridge. At the east bank of the river the two spans from pier A to pier C, comprising a 97-ft. plate-girder span and the 261-ft. truss span, were erected on falsework just downstream from the old structure (upper sketch in Fig. 2), and were then rolled into place, and simultaneously the two easterly spans of the old bridge were rolled out on timber pier extensions upstream, constructed for the purpose. This operation was carried out on Sept. 1, 1920. Immediately after the rolling, a 50-ft. girder span was temporarily placed between the end of the new span (on pier C) and the old pier 3, restoring traffic connection. At the same time the viaduct spans on the west end, beginning at abutment U, were erected up to the skew span G-F. As the new structure interferes with the old structure, a temporary single-track detour was constructed along the upstream side, connecting with the old line near pier M and making connection by reverse curve with the westbound track on the river bridge.

The viaduct at the west end has been erected at final track elevation. The spans at the east bank of the river, however, were erected at the grade of the old track and rolled at that level, and at present carry traffic at the original grade, in conjunction with the two westerly spans of the old bridge. The change in elevation is to be made at the time of placing the main channel span and the three connecting girder spans on the west bank of the channel.

Falsework is now being placed for the erection of the 434-ft. span. This, like the 261-ft. span, is to be erected immediately downstream from the present bridge, but it will be built at the new or *high* elevation. As it was necessary to restrict the new piers to the elevation established by the clearance of the old bridge, this span will have to be supported on steel end bents footing on the new piers at their present level; the bearing of the span is to be transferred to permanent shoes at the final coping level of the piers later on. These end bents will also serve as track shoes for the rolling of the span from erection position to its final place on Piers C and D.

When the channel span is ready to roll into final position, traffic will be abandoned, the two remaining old truss spans will be rolled out on upstream temporary pier extensions, the new channel span moving on its temporary supporting bents will be rolled to place, and at the same time the two previously placed new spans will be jacked up to their final elevation.

Preparatory to this movement the eastbound track on the 33rd St. viaduct (on the south bank) will have been raised to the final track elevation, so that it will make connection with the main channel structure as soon as the latter is jacked up. The two remaining girder spans on the north bank of the main channel will be placed at the time of the final rolling and jacking operations,

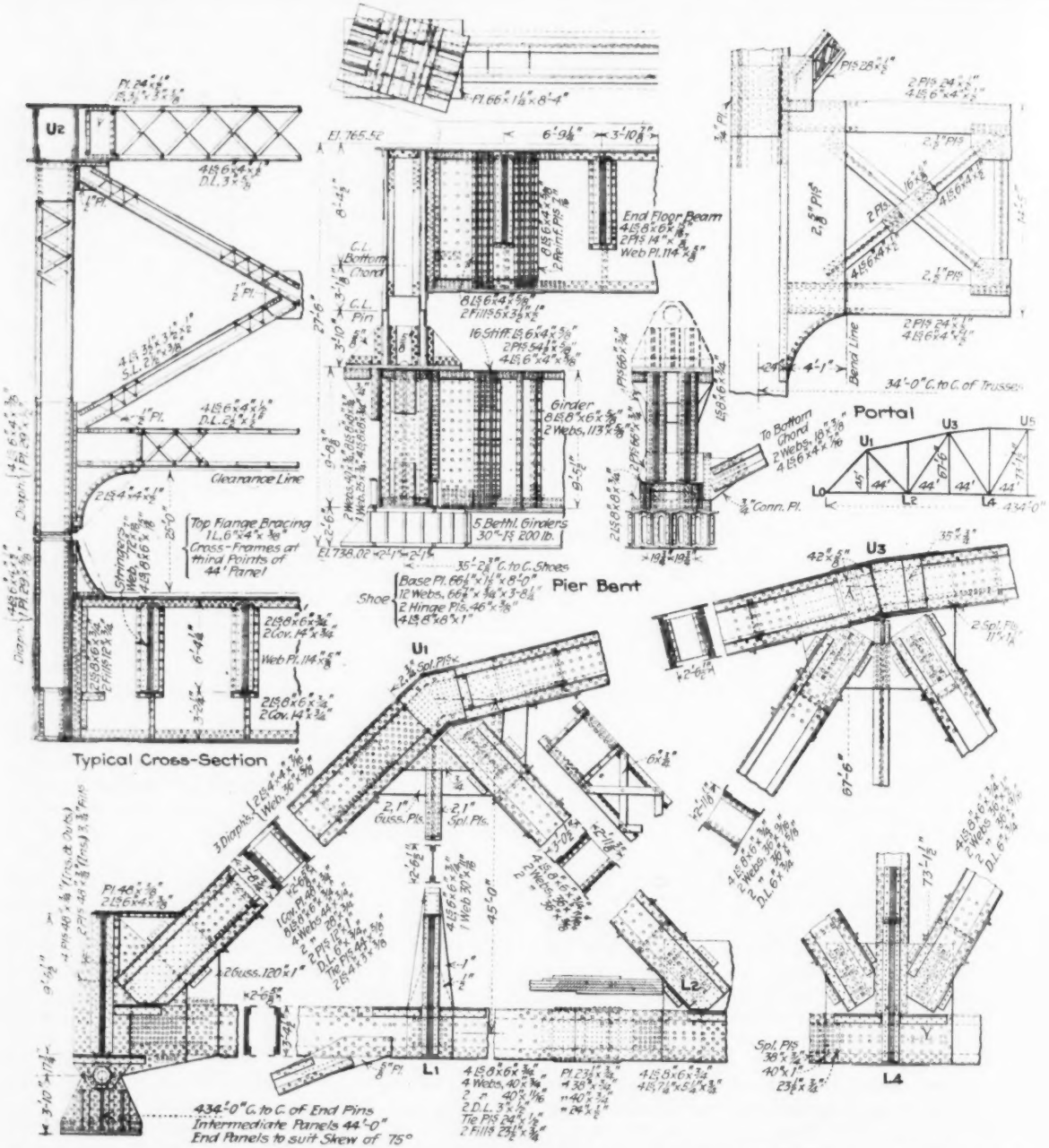


FIG. 3. REPRESENTATIVE DETAILS OF 434-FT. FULL-RIVETED CHANNEL SPAN OF PITTSBURGH JUNCTION R.R. BRIDGE OVER ALLEGHENY RIVER, WITH TEMPORARY PIER BENTS

and with this completed the eastbound track will be opened for traffic at its final elevation, and the channel spans and the north viaduct will be completely ready for service.

River traffic was passed under the third span of the old structure, counting from the east bank of the river, while the 261-ft. truss span was being erected. After the rolling of this span, the old pier below it, which carried the adjoining ends of the first and second old spans, was taken down and a channel dredged under the new 261-ft. span. River traffic was then diverted and caused to pass under this span, whereupon falsework for the large channel span was erected. This manner of dealing with the barge traffic on the river made it possible to erect both truss spans on falsework and obtain a riveted structure.

With regard to the design of the new structure, in general 1-in. rivets are used for the shop riveting throughout. In the field connections of the two large spans, 1¼-in. rivets are being used.

Attention is called to the fact that rather long panels are used in the large truss span, namely 44 ft., and that this span does not have subdivided panels. By these means secondary stresses are, to a large extent, eliminated. The longest member in this span is the middle section of the bottom chord, which is approximately 104 ft. in length. The longest web member is about 85 ft. in length.

The total cost of reconstruction of the bridge will be about $2,200,000. The work is being carried out under the supervision of H. A. Lane, chief engineer, Baltimore & Ohio R. R., Baltimore. The preliminary stages were under the direction of W. S. Bouton, engineer of bridges; the actual design, fabrication and erection work have been handled under the direction of P. G. Lang, Jr., assistant engineer of bridges. The work in the field is under the supervision of A. C. Clarke, district engineer. The American Bridge Co. contracted for the fabrication and erection of the new steel work, while the substructure was built by the Vang Construction Co., of Cumberland, Md.

Algae Cause Odors from Monona Lake at Madison, Wisconsin

Sewage Effluent, Industrial Wastes and Other Causes Negligible—Prevention by Copper Sulphate Treatment

ALGÆ growth and decay has been determined as the cause of extremely offensive odors coming from Lake Monona, at Madison, Wis., other contributory causes being insignificant. To prevent the recurrence of this condition, instead of waiting to cure it after it has arisen, the recommendation is made that the water be kept under constant biological observation during the early spring and summer of each year and that copper sulphate be applied when necessary to check an increasing growth of algæ. This conclusion and recommendation are the important points of a detailed report submitted to the city in May, 1920, by Alvord & Burdick, consulting engineers, who had been engaged to make a thorough investigation. Collaborating with them in this report were Dean H. L. Russell, of the Agricultural College and Prof. Chancey Juday of the Department of Biology, both of the University of Wisconsin. An abstract of a preliminary report on the subject by John W. Alvord was given in *Engineering News-Record*, Sept. 4, 1919, p. 469.

Three matters which have been thought by the public to be the most likely causes of the unpleasant odors are effluent from the Madison sewage-works (see *Engineering News-Record*, Sept. 11, 1919, p. 510), washings from a beet sugar factory and algæ in the lake water. In 1918, when the conditions were very bad, the odors prevailed all over and around the lake and were not localized as they probably would have been if caused at some one point. At the same time there was an abundant growth of algæ in the water.

Public opinion has placed the responsibility largely upon the sewage effluent, and some years ago a resident brought suit against the city for causing a nuisance by permitting sewage pollution of the lake. As a result of this feeling there has been a popular suggestion that the effluent should be pumped five miles to the outlet of the lake or twenty miles to the Wisconsin River. The report shows that these projects would involve investment costs of $433,000 and $1,330,000 respectively, to say nothing of operating costs, but the money would be wasted since it would not result in abating the odors from the lake.

The offensive growth consists of the so-called blue-green algæ, mainly anabœna, clathrocystis and cœlosphrærium, all of which give out odors when living. The algæ are present to some extent every year. Detached masses are driven by the wind upon the shore and beaches, where they decay and cause concentrated odors in addition to those coming from the decaying matter on the surface of the lake. The odor was most offensive and widespread in 1882, 1888, 1913 and 1918, but it is more or less noticeable nearly every year. It is said to resemble that from a very foul pigpen.

A strong argument supporting the conclusions of the report and refuting the sewage pollution theory is that the offensive odors were a marked source of annoyance and complaint in 1882, before the city had a sewerage system. The trouble was investigated at that time by Prof. William Trelease, of the University of Wisconsin, who explained the condition of the water and showed that masses of decaying algæ were the cause of the objectionable odors in that year. In 1918 and 1919 the conditions at the sewage-works, sugar plant and other suspected sources were practically identical, but algæ and odors were much in evidence in the former season and noticeably absent in the latter season.

In 1918, about four tons of copper sulphate was used in Lake Monona, being applied from time to time at troublesome points. Although this treatment was effective locally, its general effect was nullified by the fact that the entire lake was covered with decomposing algæ. In 1919, about 5½ tons were used, but the lake was admittedly free from unusual growth. This treatment was made in the usual way by towing bags filled with the chemical, but the report states that the work was not under laboratory control and that the quantities used were far below those found effective in water-works practice. Further, it states that there is no precedent for the application of this treatment to so large a body of water as Lake Monona, which has an area of 5.45 sq.mi., a shore line of 13.2 miles (of which four miles are closely built up), a depth of 27½ to 74 ft. and a volume of 4,195,000,000 cu.ft. or over 31,000,000,000 gallons.

Effluent from the sewage-works during 1919 was found to have a uniform stability of 95 per cent, which, the report explains, represents a high degree of effective purification and is incapable of producing nuisance by odors. Fish life and dissolved oxygen are abundant at the outlet of the effluent discharge into the Yahara River just above the entrance into the lake. The beet sugar factory operates late in the fall, after the period when the lake odors are most offensive, and its wastes do not produce distinctively sewage odors, although they do produce unsightly conditions. Storm waters and industrial wastes are considered insignificant as causes of pollution and trouble. Further, the report states that neither the sewage effluent nor the sugar factory wastes are important causes of stimulating algæ growth, as such growth occurs even in waters where there is no pollution.

In explanation of this opinion as to the effect of the sewage effluent, the report points out that the present flow of this effluent in the Yahara River, about 6 cu.ft. per second, is less than 4 per cent of the average flow of the river. With this effluent and other sources it is estimated that the river annually delivers to the lake about 108 tons of organic nitrogen and 18 tons of nitrates and nitrites.

Nitrates do not appear to be a direct measure of plant or algæ growth, according to the report. Although nitrates which the sewage effluent introduces into the lake in considerable quantity are an indispensable food

for plant life, it has been shown by experiment and observation that some other factor than inorganic food supply determines the extent to which these growths will flourish. There is some evidence that this factor is an organic substance and may be a waste product of certain organic life of the complex environment in which the algæ grow. At present, however, the physiology of fresh water algæ is not well understood even by specialists.

Copper Sulphate Treatment Recommended

To prevent recurrence of the objectionable conditions it is recommended that during each spring and summer the lake water should be kept under constant biological observation. When early symptoms of algæ growth are observed, particularly in abnormal amounts, copper sulphate should be applied under the direction of the biologist, in order to stop the growth and thus prevent the odors resulting from its death and decay in great quantities. The annual cost of the laboratory and control work is estimated at $4,000 to $5,000, but in occasional years, when large amounts of copper sulphate are required, this may be 50 per cent larger.

As spent sediment and harmless fungi passing into the lake with the sewage effluent make an unsightly condition and cause a popular erroneous judgment as to the source of odors, it is recommended that the effluent be carried out into the lake by a submerged wooden box conduit about 1,000 to 1,200 ft. long. This will also give better diffusion of the effluent with the dissolved oxygen of the lake water. The cost of this outlet is estimated at $12,000 to $15,000. An auxiliary recommendation is the dredging of a strip of shallow shore on the city front to prevent the nuisance arising from weed growth in shallow water, the excavated material being utilized for lake-front park development.

In a review and opinion endorsing the report, which has been added by Dean H. L. Russell and Prof. Chancey Juday, it is suggested that the outlet of the effluent conduit should not be submerged more than 20 ft., owing to the effects of temperature changes on oxygen content in the water. As to the proposed shore line dredging, it is suggested that weed growths will develop abundantly in 12 to 15 ft. of water and will facilitate the accumulation of organic matter which produces odors from decomposition. Thus a considerable depth would be necessary to effect the object sought by the proposed dredging.

Aspirators for Water Ozonization Plants

Tests of aspirators for uniting water and ozone or air in ozone plants for water disinfection are described by A. E. Walden, superintendent and chief engineer, Baltimore County (Md.) Water & Electric Co., in the October number of *Mechanical Engineering*. Of various forms of aspirators, siphons, jets and nozzles found available for trial, the best results were obtained from the Knowles spirojector, but this device "did not function at low heads any better than other types" and is "difficult to construct in either tile or enameled iron." Finally there was designed a cast-iron aspirator, enameled with white porcelain "but even this is subject to deterioration, due to high ozone concentration." The paper mentioned shows the forms of the various aspirators used, and gives tabular and graphical data of results obtained.

Letters to the Editor

Pavement Type Nomenclature

Sir—A not infrequent error in pavement type nomenclature would seem to justify the attention of writers upon highway subjects and others whose duties make conciseness not only a virtue but a practical necessity. I refer to the use of the word "concrete" without any other qualifying designation.

The definition as given by the Century Dictionary reads: "A compact mass of sand, gravel, coarse pebbles or stone chippings cemented together by hydraulic or other mortar, or by asphalt or refuse tar." This definition has been supported and substantiated by court decisions from which it is found that concrete aggregates may consist of crushed stone, gravel, sand, cinders, furnace slag or a combination of these, and the cementing material may be portland or natural cement, asphalt or tar. Correctly speaking a "concrete" pavement may, therefore, be any one of a score of designs, including asphaltic concrete, portland cement concrete, or bituminous concrete cemented with tar.

To be reasonably definite qualifying adjectives such as "portland cement" or "asphaltic" should always precede a reference to "concrete" pavements, and where further accuracy is desired the kind of aggregate should be indicated.

I believe this is a matter of sufficient importance to justify placing before your readers.

J. E. Pennybacker,
Secretary of The Asphalt Association.

New York City, Oct. 22.

[We question the soundness of Mr. Pennybacker's position. Usage, and not the dictionary, usually makes work-a-day definitions. The engineer and the contractor think of "concrete" as an artificial stone composed of fine and coarse aggregate, water and hydraulic cement. Why not accept that and call a mixed asphalt road "mixed-asphalt" road, and a penetration job a "penetration" road. The matter merits discussion and the opinion of engineers and contractors is invited.—Editor.]

Once More the Concrete Foreman

Sir—The editorial in *Engineering News-Record*, Aug. 19, p. 338, entitled "Educate the Concrete Foreman," made very agreeable reading. It expressed a thought which I have had for some time.

For about two years I have been doing concrete work in this city and I have had trouble, annoyance and bilious days. I looked for outside advice, since I could not get it here and from several sources in the States, notably from the Building Code prepared for the National Board of Fire Underwriters by Ira H. Woolson, I learned a number of things. I think I know now how to avoid troubles in concrete—but not completely if I have to rely on foremen.

The violation of the fundamental requirements of a first-class concrete structure is the universal rule. The fundamentals are very simple, but very necessary to be attended to. However, they are not and the cause of the violation is the foreman. A foreman who has had an experience in work for ten or twelve years believes himself superior to all engineers; he is hurt at the simplest remark made at his work. He knows everything, and a man that knows everything does not want advice or remarks from any other man. He believes the engineer and the contractor much below himself.

For the work of proportioning, mixing and placing concrete he appoints any of his men, generally one of his pets; it is no importance to him that the mixing is done in a muddy place, or where waves of dust are continuous or the sun burns; he does not care if the water is full of vegetable matter or if the men are smoking and drop pieces of cigarettes or cigars into the mixture. Sometimes at 3 o'clock he tells the men to make a large quantity of concrete in order to have enough till 5 o'clock. If one tells

him that the forms are leaking he answers: "that has no importance; I will plaster it." He will laugh contemptuously at the man that tells him that there are certain physical and chemical forces at work that have to be taken into consideration in order to have a good construction.

We have had English, American and German foremen here and all are affected by the same defects. It would be better to have illiterate men who would obey orders than foremen who know everything.

The ideas expressed in the editorial referred to are very much to the point. Concrete engineering (or concrete work) is a remarkable exception in its development compared with the other industries, arts and sciences. Gun manufacture, bridge building, ship and locomotive building, surveying, physics, chemistry, medicine, all were born in very humble places, in the shops, the camps and other places and took centuries or thousands of years of work and experience to reach their present stage. And theory and practice were and, in some cases, are in disagreement.

With concrete the case has been very different, for experimental stations have reduced the thousands of years that were necessary in the other arts, to a few years, and so theory and practice have gone hand in hand. Consequently the pretensions of foremen should be put down without any consideration. There is but one way of thinking in this matter, and that is to follow or be guided by the results or knowledge derived from thousands of conscientious and careful experiments.

ANSELMO MIERES Y LLERA.

Guatemala City, Oct. 1.

Should Report and Consolidate All Rainfall and Run-Off Records

Sir—In many engineering investigations it becomes of great value to have as large a number of rainfall and stream-flow records as possible. For the State of New York there are at present published something like eighty records of precipitation in the climatological data of the Weather Bureau. There are many rainfall stations maintained by private and public interests which do not report to the Weather Bureau.

It has been the idea of the writer for some time that the publication of all available rainfall data, as well as stream-flow data, in a single bulletin or other publication would be of very great value. Having this in mind a letter was written to Prof. Wilford M. Wilson of Cornell University, head of the U. S. Weather Bureau in New York State, asking if the bureau would be willing to publish such records as are obtainable. Professor Wilson states that the bureau will receive, publish and file all records of rainfall made under proper supervision in the State. The records must be reported on blanks furnished by the bureau.

If the various interests which maintain rainfall stations would turn in monthly reports to the section director at Ithaca they would confer a great benefit on others who might have use for rainfall data and in addition to that would be making the climatological data of more use to themselves, as all the obtainable information for the State would be included in the one publication.

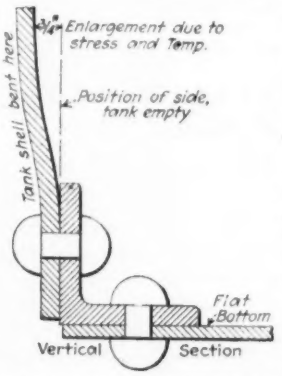
The same applies also to the matter of stream-flow records. It is suggested that additional records of flow might be published either by the State Engineer or the Conservation Commission, or both, in their annual reports and that suitable arrangements be made between the various parties maintaining such stations and one or the other of these authorities for the keeping and publishing of such records. By this means it seems that there might be from two to three times as many records of flow brought together under the covers of one book as are now obtainable from the publications of these two departments.

As an extension of this idea the writer would suggest that the American Society of Civil Engineers might well collect, collate and publish the various stream-flow and rainfall records obtainable for past years. It is suggested that this might take the form of a loose-leaf book of standard letter size (8½ x 11 in.) or of small bulletins covering a given stream or stream-flow station which could be punched and inserted in a standard loose-leaf cover. The same system could be applied to rainfall records. The plan suggested would enable interested parties to obtain the particular information without going to the expense of purchasing the entire collection.

BYRON E. WHITE,
Utica, N. Y., Oct. 26. Engineer Utica Gas & Electric Co.

Bending Stress in Tank Shells Due to Restraint of Bottom

Sir — Concerning the collapse of a molasses tank in Boston, the remarkable similarity of this case to the failure of the water reservoir of a gas holder in New York about twenty years ago is notable. In that disaster a number of lives were lost and great property damage occurred, and the owners and their engineers were able to convince a coroner's jury that the failure was caused by dynamite exploded in the tank by persons unknown, which also is the theory advanced in this instance. In each case the cause was undoubtedly the same, and the same danger exists in all flat-bottomed tanks of large size as usually constructed. The practice of following apparently safe precedents, well established as safe for small structures, as the basis for design and detail of much larger structures, has been responsible for some large failures, notably that of the Quebec bridge. The error in the case of flat-bottomed tanks is due to basing the calculation of strength on pure ring stress only, neglecting the misnamed secondary stresses caused by the restraint of the ring by the comparatively unyielding flat bottom. These stresses produce flexure in the side plates near their connection with the bottom. Experience in boiler practice has shown the necessity for properly providing for these stresses, even in case of small diameters, by a curve of sufficient radius to distribute the bending and thereby reduce the stress.



SKETCH OF TANK SHELL NEAR FLAT BOTTOM

As the failure of the molasses tank occurred in January, it is possible that the liquid was warmed to reduce the viscosity. It can be shown that such heating would considerably increase the bending stresses, and that the combined tension and bending stress closely approached the ultimate strength of the material. If the tank had been filled several times before failure, it is probable that even a few repetitions of this great overstress had initiated progressive fatigue cracks, even without the aid of temperature stress. From the published facts the increase in diameter due to ring tension, tank full, would be about 1.25 in.

A small temperature difference would increase this 0.25 in., and the accompanying sketch shows the resulting condition. In view of these conditions and of the published estimate of 1.6 as the factor of safety based on ultimate strength and pure ring tension only, there appears to be no need to search for an outside agency to account for this failure.

GEORGE ROE.

Portland, Ore., Oct. 18.

Unusual Sewerage Conditions in Texas

Of 103 cities in Texas the sewers in 23 are owned by companies, of 70 by cities, while the ownership of 2 is unknown and 8 cities have no sewers. Of the companies 22 of the 23 (one did not report on the subject) charge for the use of sewers. Of the cities 51 charge and 10 supply sewerage service free.

HINTS FOR THE CONTRACTOR

Traffic Help During Street Obstruction

BY UTILIZING part of a wide sidewalk as a roadway the trenching of Michigan Ave. at Randolph St., Chicago, for a footway undercrossing, was effected with a minimum of interference to the extremely heavy automobile traffic on that thoroughfare. The work was done in two sections, so that only half the width of the roadway was blocked at one time. A fence was built along the sidewalk of the side open to traffic, leaving a narrow passage for pedestrians, the gutter being filled in with planks to form a smooth roadway. Automobiles in one direction swung out through this curved widening of the roadway, instead of all vehicles being confined to the half width of the roadway proper. The Nash-Dowdle Co. has the contract for this undercrossing, which will form an approach to the suburban terminal station of the Illinois Central R.R.

Overdriven Piles Form Coal-Like Substance in Gravel Bank

By B. H. Piepmeier

Engineer of Construction, Illinois Division of Highways, Springfield

ON THE Illinois state road Project 5, near Chillicothe, the highway crosses seven tracks of the Atchison, Topeka and Santa Fé R.R. at grade. It was decided to make a grade separation at this joint by taking the highway under the railroad. A temporary trestle carried by 30-ft. piles was constructed to support the

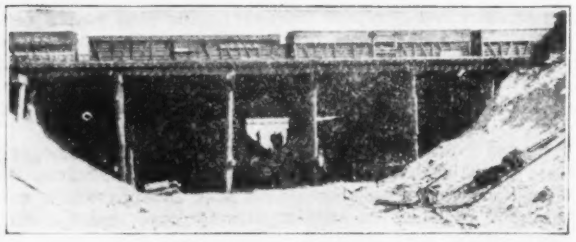


FIG. 1. PILE TRESTLE CARRYING TRACKS DURING CONSTRUCTION OF UNDERCROSSING

tracks during the time the excavation for the under crossing was made and the permanent structure built. The effects of the pile driving, as revealed in the subsequent excavation, were remarkable.

The piles were of oak, standard size and well seasoned. They were pointed with a steel point and capped with the usual ring and plate, then driven with the standard railroad steam piledriver. They were to be driven their full depth through a well graded bank gravel (2-in. pebbles to sand) above water level.

All piles were apparently driven their full depth even though the driving was very difficult. In some instances 24 to 30 hours of constant driving with the large steam hammer were required to sink the piles to the proper depth.

After the trestle was completed the excavated material was removed from beneath the tracks and from

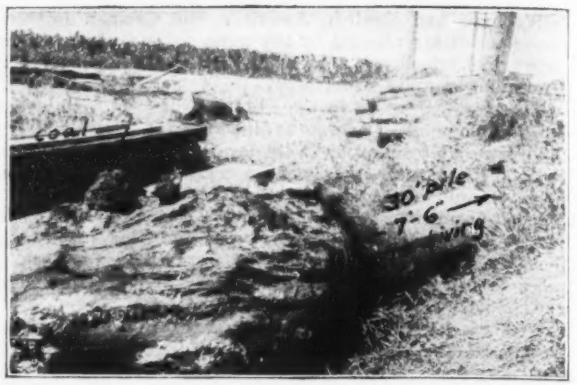
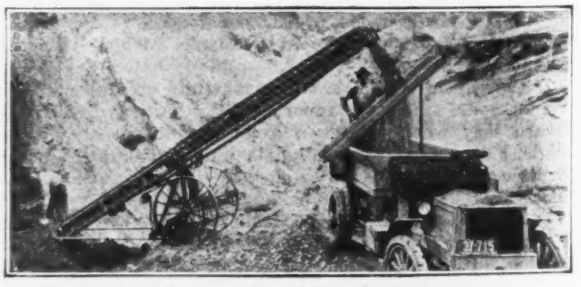


FIG. 2. PILE COMPRESSED TO ONE-FOURTH ITS LENGTH

around the piles. Careful examination showed that over 50 per cent of the piles had failed to penetrate their full depth. Many had buckled and had been compressed into all kinds of shapes. In a number of instances the 30-ft. piles had been merely compressed into a mass of from seven to ten feet in length, and from 18 to 24 in. in thickness. In a few cases 10 to 15 per cent of the compressed mass was apparently pure coal. Over half the piles had to be redriven after the excavated material had been removed.

Pit Sand Rapidly Screened and Loaded Into Auto Trucks

THE accompanying illustration shows a novel scoop conveyor installation at the sand pit of Somers & Sons, Wyoming, Pa. The screen was placed in the truck, being supported in the truck by a pole and on the edge of the truck by a small block of wood. The 24-ft. scoop conveyor was then placed so that the ma-



SAND SCREENED AND LOADED

terial, when discharged, would fall near the top of the screen. The screen being set at the proper angle the large lumps rolled off out of the truck while the "fines" fell through.

With this arrangement 5 tons of sand were loaded and screened in 7 min. In addition to money saved on the loading operation, additional revenue was obtained by delivering screened sand.

NEWS OF THE WEEK

New York, November 4, 1920

German Exports Exceed Imports in April and May

(From "Engineering News-Record's" Berlin Correspondent)

For the first time in years the money value of exports from Germany was greater than that of imports during April and May of this year, according to figures just made public. In April, 1920, the balance of exports over imports amounted to 12 per cent and during May, approximately 20 per cent. For the year 1919 the imports were approximately three times the exports. For the first five months of 1920 the exports approximated 83 per cent of the imports.

When studying the attached table of comparisons between pre-war and 1919 and 1920 figures, full account must be taken of the depreciated value of the mark. The increase of imports during the years 1919 and 1920 is partly due to the low purchasing power of the money and partly to the fact that there was practically no control of the imports at the western frontier. The money value of exports has increased considerably, but it is believed that their quantity is below that of the pre-war level.

IMPORTS AND EXPORTS OF GERMANY

	Import Mill. Marks	Export Mill. Marks
1919		
January	397	161
February	408	195
March	440	292
April	626	770
May	1,468	251
June	2,688	406
July	3,538	570
August	3,817	735
September	4,191	790
October	5,179	1,089
November	4,446	1,284
December	5,178	4,014
Total	32,376	10,057
1920		
January	6,560	3,219
February	5,932	4,262
March	5,683	4,261
April	4,768	5,344
May	5,537	6,647

Pennsylvania Builds 26 Mi. Durable Highways in a Week

The Pennsylvania Highway Department has announced that during the week ending Oct. 14, all Pennsylvania records on road construction were broken. During that week on various construction projects in the state, 26.27 mi. of modern-type highway were put down. During the present construction season and up until Oct. 19, the State Highway Department of Pennsylvania has constructed approximately 320 mi. of modern-typed roadway.

During the season of 1920 the maintenance forces of the highway department have entirely resurfaced approximately 315 mi. of macadam roadway and have oiled approximately 1,300 mi. of road.

Vermont's New Governor Is An Engineer

As the result of the Election Nov. 2, an engineer, James Hartness, of Springfield, Vt., becomes the new Governor of Vermont. Mr. Hartness, the Republican candidate for office, is past-president of the American Society of Mechanical Engineers and was instrumental in organizing the Jones & Lamson Machine Co. at Springfield 30 years ago. His efforts are considered to be responsible in large part for the industrial growth of Springfield.

JAMES HARTNESS, VERMONT'S ENGINEER GOVERNOR

Electrical Engineers Name Federation Representatives

The Board of Directors of the American Institute of Electrical Engineers, at its meeting Oct. 8, appointed the following representatives of the Institute on the American Engineering Council, the governing body of the Federated American Engineering Societies: Comfort A. Adams, Cambridge, Mass.; A. W. Berresford, Milwaukee, Wis.; H. W. Buck, New York, N. Y.; F. L. Hutchinson, New York, N. Y.; W. A. Layman, St. Louis, Mo.; William McClellan, Philadelphia, Pa.; L. F. Morehouse, New York, N. Y.; L. T. Robinson, Schenectady, N. Y.; Charles S. Ruffner, New York, N. Y.; L. B. Stillwell, New York, N. Y.; Calvert Townley, New York, N. Y.

The Florida Engineering Society has appointed L. R. McLain to represent it at the first meeting of the American Engineering Council, Nov. 18 and 19, at Washington, D. C.

Prof. Whipple Speaks of His Work in Europe

Tells Water-Works Men About Activities of Sanitary Department of League of Red Cross Societies

The chief feature of the meeting of the New York Section of the American Water Works Association, Oct. 20, was an address by Prof. George C. Whipple, of Harvard University, who from February until October of this year was chief of the Department of Sanitation of the League of Red Cross Societies, with headquarters at Geneva, Switzerland. Prof. Whipple outlined the work of his department abroad and some of the prospective work of his successor at Geneva, Colonel F. F. Longley.

Among the subjects to which Prof. Whipple gave special attention while in Europe were sanitary surveys, a scheme for which was outlined; water supply studies, and public health education. Colonel Longley, Prof. Whipple said, is now engaged on a glossary of terms used in sanitation and public health. He also stated that the League of Red Cross Societies, working with the Tuberculosis Commission of the Rockefeller Foundation, is carrying on a study of public water supplies in France. It is expected that water supply studies will be made in other European countries, inasmuch as in various parts of Europe the public water supplies are insufficient in quantity and quite unsuitable in quality. Moreover, there are some large cities that have no public water supplies at all.

As an illustration of public water supply needs that have been accentuated by war conditions, Prof. Whipple stated that in Roumania and elsewhere in Continental Europe filter plants and pumps are out of use entirely on account of the lack of some small part which would cost very little, but cannot be secured. The same general condition applies to transportation in Europe.

Incidentally, Prof. Whipple stated that France is planning to enlarge its canals.

Public Health Education

As to public health education in Europe, Prof. Whipple said that outside of England there is very little education in public health. Some instruction in the subject is given in medical schools, but this is by doctors and is quite inadequate, especially along sanitary lines. Prof. Whipple spent two or three months visiting European universities, particularly in Switzerland. He was well received and the indications are that before long a school of

public health will be established in Switzerland. This may be a Swiss government school or it is possible that it will become international in character, depending on whether or not arrangements are made under which the school will be supported by the League of Red Cross Societies. Prof. Whipple has been asked to make a survey of health education in Europe.

A question remaining to be settled is how far the League of Red Cross Societies, which is made up of representatives of societies in some thirty countries of the world, shall go in public health work. Prof. Whipple expressed the opinion that it was important to remember that public health is largely a governmental function and that in this field the Red Cross Societies should not encroach. Earlier, it was thought that the League of Red Cross Societies should go extensively into public health and sanitation, but the feeling is growing that the work should be taken up instead by an International Department of Public Health, under the League of Nations, confining the Red Cross efforts to educational work and emergency relief activities.

The next meeting of the New York Section of the American Water Works Association will be on Dec. 1, when a trip will be made to New Milford, N. J., to visit the works of the Hackensack Water Co.

Shipping Board To Sell Housing Projects

The United States Shipping Board is to dispose of all the housing projects in which it owns capital stock. When its housing program was inaugurated money was advanced to local realty companies or housing companies organized by the shipbuilder concerned. The builder constructed the houses on the land owned by them and the Shipping Board took back from the local realty companies mortgages covering the amount of the houses in each case. The board also became the owner of various housing projects by the acquisition of the capital stock of a number of realty companies.

The board now plans to dispose of such projects. The plan for the disposition contemplates selling these projects to manufacturing and business concerns of a substantial character or disposing of the houses by individual units.

In order that local conditions may be considered and fair terms arranged, it is provided that each project shall be passed upon by competent local appraisers who shall report the value of the buildings, the lots and parcels of land and the most advantageous methods and terms of sale. Such a plan enables the appraiser to present the local conditions which the board will consider in offering the various projects for sale.

The projects affected by this announcement are located at Wilmington, Del.; Camden, N. J.; Chester, Pa.; Loraine, Ohio; Wyandotte, Mich.; Jacksonville, Fla.; Groton, Conn., and Dundalk, Md.

Substantial Salary Increase for New York Engineers

(By Arthur S. Tuttle, Chairman, Engineering Council's Committee on Classification and Compensation of Engineers)

Under a recent general readjustment of salaries of municipal employees in the City of New York the compensation for all positions carrying a salary of less than $7,500 per annum has been increased. In the case of salaries of less than $1,500 the increase is at the rate of 22 per cent with a minimum of $200. In the case of salaries ranging from $1,500 to $2,500 per annum the increase is 20 per cent. To salaries upwards of $2,500 per annum $500 has been added, but salaries plus increases have been limited to a maximum of $7,500.

Position	Number of Employees	July 1, 1915	Average Salary After Aug. 20/20	Per Cent Increase
Chief Engineer (including Deputy Chief Engineer)	20	$7,270	$7,450	2
Engineer	50	3,850	4,470	16
Senior Assistant Engineer	86	2,850	3,420	20
Assistant Engineer	171	2,180	2,760	27
Junior Assistant Engineer	56	1,630	2,370	45
Senior Aid (Chief Instrumentman and Chief Draftsman)	64	1,700	2,440	44
Aid (Instrumentman and Draftsman)	285	1,500	2,180	45
Junior Aid (Junior Draftsman and Rodman)	150	1,030	1,720	67

The effect of these increases upon the compensation of the engineering force of the city as organized near the close of last year is shown in the accompanying table, which also gives a comparison with the average compensation for the same positions as fixed before the shrinkage in the value of the dollar became pronounced. All of the positions are classified on the basis recommended by Engineering Council's Committee on Classification and Compensation.

Comparing the present average compensation with the compensation schedule proposed by the committee, it will be seen that the average pay of junior aids and junior assistant engineers under this scale is substantially greater than that tentatively recommended; that the average compensation for aid is practically the same as that proposed by the committee; that the average compensation for senior aid and assistant engineer is very close to the committee's minimum; and that for the grades senior assistant engineer, engineer and chief engineer the average salary, after the allowed increases have been added and notwithstanding the appreciable betterment in the lower grades, is still approximately $650 to $1,500 per annum below the minimum proposed by the committee.

Health Officers to Discuss Housing at Detroit

A national conference of health officers to consider housing questions will open at Detroit, Mich., on Nov. 30, according to an announcement made by Dr. Henry F. Vaughan, health commissioner of Detroit.

Proposed Engineers and Architects Registration Bill for Ohio

The Association of Ohio Technical Societies has prepared a combined engineers and architects registration bill. Every technical organization in the state is asked to give consideration to the present draft, endorse or submit suggestions. When these suggestions are received a meeting of delegates will be called prior to Dec. 1, for final action on the bill and the adoption of a plan of campaign for its passage.

The bill is of the blanket or omnibus nature, following the medical and legal practice of giving uniform certificates for all branches. A long definition of the practice of engineering and architecture is given because it is the opinion of the committee drafting the bill that the first attempt to enforce the bill would inevitably lead to a definition proposed by persons much less competent to do so than the members of the technical professions.

Provisions of Bill

Only citizens of the United States and Canada or those who have made a declaration of the intention of becoming a citizen are eligible to receive a certificate. The usual reciprocity clause is included. The fee of applicant for consideration without examination is $10 and for examination $25. No renewal of certificates is required. Violation of the law in practicing professional engineering, architecture or surveying without a certificate is denominated a misdemeanor and the punishment is a fine of from $5 to $100 or imprisonment of from 30 days to 1 year. A heavier fine, $100 to $1,000, is to be levied on any person who fraudulently impersonates a registered engineer, architect or surveyor.

The bill is a compromise drawn up by a committee, originally appointed in January by C. L. Rood, president of the Ohio Engineering Society. The committee was later adopted by the Association of Ohio Technical Societies and endorsed by the Ohio Assembly of the American Association of Engineers. It was submitted in preliminary form July 9 to a committee of delegates representing most of the technical societies of the state and the Ohio Association of the American Institute of Architects. The personnel of the committee is as follows: E. A. Lawrence, W. A. Stinchcomb, R. E. Hempel, E. G. Bradbury, chairman, and F. P. Obee, secretary.

Military Engineers Discuss Army Reorganization Bill

The general plan of administration of the army reorganization bill as contemplated by the General Staff, War Department, as well plans for the administration of the various technical services, was the main subject of discussion by members of the New York Post, Society of American Military Engineers, at its first fall meeting Oct. 26 at the Engineering Societies Building, New York City. The meeting began a series of discussions which are to be held throughout the year, to be participated in by both officers now in the military establishment and those in civilan practice. It is hoped, by these meetings, to create a close co operation between civilian and military engineers.

General features of the reorganization bill were explained by Leiut.-Col. John W. Gulick, War Plans Division, General Staff; plans for the technical services were discussed by Major Donald H. Connolly, General Staff. The third principal speaker was Col. William Barclay Parsons, chairman of the Post's military affairs committee, who outlined a plan providing for the interchange of civil and military engineers whereby the civilian engineer would be assigned to troops for a certain period during the year and the military engineer would replace him in his civilian capacity.

One of the details of the reorganization bill as explained to the military engineers was the plan whereby all reserve officers, in case of an emergency, could be immediately given definite assignments. Not only would the bill retain divisional organization of engineer troops, but corps, army and general headquarters units, so that in emergencies long periods of unassignment of reserve officers would be obviated. It was also pointed out that reserve officers, with their consent, may be called upon to assist the Corps of Engineers in river and harbor work.

Most of the program for the entire year's meeting has been arranged. The next meeting of the New York Post will be Dec. 14. Colonel Roger D. Black, formerly Corps of Engineers, U. S. A., will discuss the "Relations Between Staff and Services." The annual dinner is to be held some date in January. The other meetings and the subjects to be discussed are as follows: Feb. 10, "Functional Organizations of Engineers," by Major George R. Spalding, Corps of Engineers, U. S. A.; April 13, "Military and Engineering Defense of New York. A trip to West Point will be made in May.

Burlington, N. J., May Buy Out Private Sewer Company

After lengthy negotiations an agreement has been reached between the city authorities and the Burlington Sewerage Co. under which the city will buy the sewerage system of the company. The council has passed an ordinance appropriating $85,000 of bonds to pay for the system.

May Cross Toronto Harbor by Bridge or Tunnel

Projects for a bridge or a tunnel to cross the "western gap" of the harbor at Toronto are being studied by the Department of Public Works, it has just been announced. A bascule bridge was investigated some time ago; its cost at present prices would be at least $700,000. Such a structure would probably reduce the available channel width for navigation, however, and a tunnel is being studied by the department as an alternative. The construction cost of a tunnel is believed to be greater than that of a bridge, but land damages and maintenance are expected to be lower. Decision on proceeding with one or the other type of crossing is likely to be made by next season, as the Dominion Government and the Board of Harbor Commissioners have an agreement that a crossing shall be provided.

Entire Staff Resigns as Protest Against Chief's Defeat

As a protest against the defeat of Lloyd Aldrich, county engineer of Sonoma County, Cal., at the election Aug. 31, the entire county engineering organization, numbering 41 men, has resigned. This action is said to be the result of the attitude of certain public officials and politicians toward Mr. Aldrich and the lack of support of the people of Sonoma County. The members of the county engineer's staff state their refusal to subordinate themselves to the new administration resulting from the September election. There follows a copy of a resolution passed recently and signed by the 41 members of Mr. Aldrich's staff:

Whereas, the outcome of the county election of Aug. 31, 1920, is an indication that the efforts of our chief and ourselves to honestly and efficiently conduct the engineering work of Sonoma County have not received public appreciation, and

Whereas, We know the great difficulty that will attend any attempt on our part to maintain an equally high standard of engineering and efficiency under the proposed new administration, now therefore be it

Resolved, That we, the engineering organization of Lloyd Aldrich, County Engineer of Sonoma County, do hereby express our great confidence in the ability and integrity of our chief, and our refusal to subordinate ourselves to authority governed by ideas which we believe are not in accord with the public welfare and the best engineering practice, by making our resignation from the service of Sonoma County coincident with his own.

New Jersey Highway Department Plans Winter Conference

A two-day convention of the staff of the New Jersey State Highway Department will be held in Trenton during the coming winter to co-ordinate activities and develop an *esprit de corps*. No date for the conference has yet been set. It is planned to have a collection of road building materials on exhibition at the laboratory of the department in Trenton. The participants will include division engineers, assistant engineers, road inspectors, foremen, heads of various departments, members of field parties and all others connected with the department.

Non-Partisan Political Meeting of New York Engineers

To carry out its primary purpose of dealing with public matters involving engineering, the New York chapter of the American Association of Engineers held a non-partisan political meeting at the Engineering Societies Building on Oct. 12, 1920. The two major national parties had been asked to send official representatives to deal with the question, "Which party makes the strongest appeal to the engineer?" United States Senator J. T. Robinson, former Governor of Arkansas, was present as the Democratic representative, and Elon H. Hooker, president of the Electro Chemical Co., of Niagara Falls, and long a leading figure in state politics, represented the Republicans. In addition to the addresses of these speakers, answers of candidates for President and Governor to a series of questions of engineering importance were presented to the meeting.

Of the national questions (see our issue of Sept. 23, p. 624), that asking support of a movement for a department of public works was perhaps the most important. Governor Cox (Democratic) answered this and all the other questions with specific affirmatives. Senator Harding (Republican) replied by general statements with an apparently affirmative import. As to state issues, Governor A. E. Smith (Democratic) and Judge N. L. Miller (Republican) were asked the following questions:

Questions Asked

(1) Are you in favor of the establishment of a budget system for all state expenditures? (2) Are you in favor of the establishment of a bureau of public works, under efficient engineering direction? (3) Are you in favor of placing the planning, construction and maintenance of a comprehensive and modern highway system under such a bureau? (4) Are you in favor of the appointment of competent engineers as part of the membership of public service commissions and other bodies supervising work largely of an engineering nature? (5) Are you in favor of aggressively seeking a solution of the problems involved in making New York City the foremost port of the world?

Affirmative answers to all these questions were given by both candidates. It was emphasized at the meeting that these declarations by the leading candidates give the association means for following up the reforms covered by the questions.

In discussing national issues of particular appeal to engineers, Senator Robinson reviewed the questions addressed to the presidential candidates, and emphasized Governor Cox's categorical support of the measures outlined, at the same time denouncing the qualifications contained in the replies of Senator Harding. His address was interpreted as putting the Democratic party clearly on record in support of

the public works department and other measures dealt with in the inquiry.

Mr. Hooker emphasized the record of the Republican party in constructive legislation as an assurance of its performance in the same direction during the next Congress, and severely arraigned the inefficiency and lack of sound business methods of the Democratic administration, an arraignment which he illustrated very effectively by citing his personal experiences with the War Department. Speaking as an engineer to engineers, Mr. Hooker dwelt on their responsibility to the public, and urged them to use their influence to bring about increased efficiency in government.

Hearings on New York-Delaware Intercoastal Waterway Planned

In accordance with a provision of the latest Rivers and Harbors Act, hearings are to be held by the Corps of Engineers, U. S. A., looking into the feasibility and desirability of a proposed intercoastal waterway from New York Bay to the Delaware River. These will be in the Army Building, 39 Whitehall St., New York City, Nov. 11, 1920, at 11:15 a.m. and in the Mayor's Reception Room, City Hall, Philadelphia, at 11:15 a.m., Nov. 12.

Transformer Explosion Kills Twelve

Shortly after starting two new transformers in a substation of the Niagara Falls Power Co. at North Tonawanda, N. Y., on Oct. 31, an explosion occurred in the substation which resulted in the death of twelve men from oil burns. Press reports state that the transformers burst, apparently because of an internal short-circuit.

Early Reissue of Road Materials Shipping Permits Probable

Issuance of permits authorizing the use of open-top railroad cars for road-building materials for urgent requirements probably will be resumed in the near future. When in the early part of October it became necessary to find 2,000 additional cars daily to speed up coal distribution in the Middle West, the Interstate Commerce Commission declined to renew any of the outstanding permits for the transportation of road material or other urgently needed freight in open-top cars. The suspension of the priority order covering coal for shipment on the Great Lakes will release a great many cars, but as coal distribution has been held up in the Middle West and in the East while the Northwest was being given its supply, there is some uncertainty as to the number of cars it will be possible to release from the coal trade. A definite policy in this connection probably will be worked out within the next few days.

Two More Societies Join Engineering Federation

Two more societies have become charter members of the Federated American Engineering Societies, in addition to the fourteen listed in the Oct. 21 issue of this journal, p. 817, thus making the total sixteen. The Engineering Society of York, Pa., voted in favor of joining the federation at its meeting Oct. 18, while the Washington Society of Engineers took affirmative action Oct. 20.

Conference on Employment and Vocational Education

On the tentative program of the conference on employment and vocational education, to be held Nov. 12 at the Congress Hotel, Chicago, are scheduled eleven papers, four group meetings and a discussion in the general meeting of the group findings. The conference, which is sponsored by the American Association of Engineers, will consider the problems of employment which are confronted by non-commercial employment bureaus and the relation between employment service and education.

"Placing the Graduate in His First Position" is the subject of an address to be delivered by A. B. Crawford, director of the bureau of appointments of Yale University. The attitude of the employer toward the man placed in his employ by the employment bureau will be outlined by Frank D. Chase, president of Frank D. Chase, Inc., of Chicago. Employment office administration will be discussed by George P. Hambrecht, chairman of the Industrial Commission of Wisconsin. The relation between education and industry will be explained by John B. Densmore, director-general of the Employ-Service. One of the important addresses is that to be delivered by James P. Munroe, vice-chairman of the Federal Board for Vocational Education, on "Vocational Advisement as a Prime Function of Vocational Education." J. H. Libberton, manager of the service bureau, Universal Portland Cement Co., will speak on "Fitting College Students for Success."

Bankers Endorse Federal Aid Highway Work

A continuance of federal aid highway work and the reclamation of arid lands are recommended in one of the resolutions adopted by the American Bankers' Association at its meeting in Washington last week. The resolution reads:

"The association favors the present arrangement of co-operation between the Federal and State Governments in the construction of national highways as the best system available, considers that a five-year building program for the national highways will prove most satisfactory, adequate appropriations being made. We favor such Federal assistance as is possible toward the continued reclamation of irrigable arid lands."

Industrial Information Bureau in China Organized

The Government Institute of Technology at Shanghai, China, will open next February a Bureau of Information for alumni. The school is under Chinese government support and prepares engineers and railway administration men with a technical education. These men often are located away from the port cities and when they desire information regarding equipment find it difficult to obtain. To meet this need the school is about to open the bureau.

Manufacturers who are interested are invited to send catalogs, specifications, designing data, approximate costs, samples or models. No sales will be made nor attempted. Impartial information alone will be offered. A member of the faculty (H. A. Vanderbeek, 5 Cammann Place, Somerville, N. J., until December, 1920, and Box 951, U. S. P. O., Shanghai, China, after that date) is now in America on leave and will be glad to communicate further with any who desire information regarding the China field.

Pennsylvania Highway Contractors Form Organization

At a meeting of the Pennsylvania highway contractors, held at Harrisburg recently, a temporary organization was appointed to draft a constitution and by-laws and arrange other details for an organization to be known as Associated Pennsylvania Highway Contractors. H. H. Wilson of Winston & Co. has been made chairman of the temporary organization and E. J. Harding, of the Associated General Contractors of America, has been loaned by that organization to assist in perfecting the permanent organization of the new association.

A general meeting and banquet for the purpose of arranging a permanent association will be held at Harrisburg in the near future. Sixty contractors engaged in constructing state roads in Pennsylvania attended the preliminary meetings.

Board of Purification of Waters Begins Work in Rhode Island

Under a recent legislative act "to prohibit and regulate the pollution of the waters of the state," a Board of Purification of Waters assumes control of water pollution other than that affecting the purity of waters for drinking purposes and ice supply, which are under control of the State Board of Health. The board consists of Dr. Thomas H. Connolly of Warren, Giles W. Easterbrooks of Pawtucket, and Harold T. Merriman of Providence. The board is authorized to investigate on complaint or its own motion any alleged cases of pollution, and after hearings to give orders for the cessation of the same. Specific jurisdiction is given over the discharge from steamers or other vessels of petroleum, gasoline, kerosene, tar, oil, or any product or mixture thereof into state waters.

Railway Bridge Builders Hold Meeting at Atlanta

The American Railway Bridge and Building Association held its thirtieth annual meeting at Atlanta, Ga., Oct. 26-28, attended by 250 members. A paper on "The Use of Electricity for Pumping Water" was presented by C. R. Knowles, superintendent water service Illinois Central R.R. Mars Johnson, assistant engineer Illinois Central R.R., presented a paper on "The Erection of the St. Charles Air Line Bridge at Chicago," illustrating it with motion pictures. Other motion pictures of various bridge work on the Illinois Central were shown by J. K. Melton, official photographer of that road. A paper on housing and boarding the maintenance employees was presented by Hunter McDonald, chief engineer, Nashville, Chattanooga & St. Louis Ry. H. C. Boyden, Portland Cement Association, presented a paper on the proportioning of concrete mixtures.

Committee Reports

Committee reports and discussions included the following subjects: Abuse of treated material; repair and maintenance of tank hoops; spray painting; maintenance of timber docks; maintenance of bridges during filling, and maintenance and repair of freighthouse floors.

Mr. Knowles, of the Illinois Central, briefly reviewed the development of electric pumping at railway water stations, as electric power has become more generally available. Now the cost of electric power for pumping is usually lower than the cost of fuel that would be required for a steam plant, and an electric pumping plant will require a building of approximately one-third the size of that required for a steam plant of the same capacity.

Following the report on the abuse of treated material, Hunter McDonald, chief engineer Nashville, Chattanooga & St. Louis Ry., described the satisfactory results secured on that road during a period of twenty years in the use of galvanized iron sheets over caps and stringers to protect them against decay. In connection with the report on repair and maintenance of tank hoops, the discussion brought out a preference for round hoops on grounds of decreased breakage and less injury to timber. The report on spray painting stated that the results depend on the skill of the operator, and in the discussion which followed it was stated that spray painting is economical with experienced operators, the waste paint being offset by the reduction in labor.

Research in Hollow Tile

The hollow clay tile manufacturers association has appointed H. D. Foster as research associate to work at the Bureau of Standards on problems of interest to the membership of this association.

Hoover Sees Opportunity for Profession in Federation

Commenting upon the Federated American Engineering Societies, Herbert C. Hoover, president of the American Institute of Mining and Metallurgical Engineers, in a recent statement given out by the Joint Conference Committee, said, in part:

"The Federated American Engineering Societies is of such portent that it seems to me real co-operation can be accomplished in full measure only by membership in it and that only through such combined action can we secure the measure of public service we all desire. The object of this organization, as stated in the constitution, is to further the public welfare wherever technical knowledge and engineering experience are involved, and to consider and act upon matters of common concern to the engineering and allied technical professions. Here is the opportunity for the engineering profession to show its solidarity and accept this opportunity of performing its duty to the nation, which rests upon the profession as a whole and cannot be performed by any component part in an individualistic effort."

Delegates to Federation Meeting

D. J. Sterrett has been appointed a delegate to represent the Detroit Engineering Society at the first meeting of the American Engineering Council in Washington, D. C., Nov. 18-19.

W. B. Powell will be the delegate of the Buffalo Engineering Society at this meeting.

Second Span of Key Bridge Is Placed

A second temporary steel span has been successfully placed in the course of the construction of the Key bridge at Washington. This span, which is 187 ft. in length, was successfully placed, like its larger predecessor, by floating it into position on barges and allowing it to settle into place with the outgo of the tide.

New British Cement Specification

The British standard specification for portland cement which was first issued in 1904 has been recently revised. The new edition, just issued, supersedes that published in 1915. In the revised specification no cement to which slag has been added or which is a mixture of portland cement and slag will comply with the specification. The specific gravity test and the aeration of cement before testing for setting time have both been eliminated. Other modifications refer to the sampling of cement stored in deep bins, the calculation of the lime ratio, setting times, and the supplying of certificate by the seller. The specification can be obtained from the British Engineering Standards Association, 28 Victoria St., London, S. W. 1.

Concrete Ship Lost in Collision

On the night of Oct. 29 the concrete ship *Cape Fear*, which was built by the United States Shipping Board at Wilmington, N. C., was sunk in the deepest part of Narragansett Bay in a collision with the Savannah Line steamer *City of Atlanta*. The *Cape Fear* was bound south out of Providence in ballast and the *City of Atlanta* north for Providence with a cargo of pig iron. How the accident happened has not been definitely determined. It is reported that the weather was clear and only a light sea running.

The *City of Atlanta* apparently hit the *Cape Fear* head on amidships, and the concrete ship remained above water only a few minutes. Twenty-three of the thirty-four men of the crew of the sunken vessel were rescued, but the remaining eleven are at present unaccounted for.

The *Cape Fear* was built by the Liberty Shipbuilding Co. at Wilmington, N. C., during the war. She is 282 ft. long overall, 46 ft. beam, 28 ft. depth, having a full cargo displacement of 6 175 tons, a deadweight of 3,257 tons. The vessel was described in *Engineering News-Record* July 4, 1918, p. 17.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY CIVIL ENGINEERS, New York City, Jan. 19, 1921.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Washington, D. C., Dec. 13-16.

FEDERATED AMERICAN ENGINEERING SOCIETIES, New York; Washington, D. C., Nov. 18-19.

NATIONAL DRAINAGE CONGRESS, Chicago; Atlanta, Ga., Nov. 10-12.

The Rochester (N. Y.) Engineering Society, on Oct. 26, was addressed by Edwin A. Fisher, consulting engineer and superintendent of city planning, on "City Planning and Zoning of Rochester."

The Engineering Society of Western Mass., at its meeting, Nov. 11, at Westfield, Mass. will be addressed by Prof. L. P. Breckenridge, Yale University, on "The Evolution of the Cast-Iron Heating Boiler as relating to the Problem of Power and Fuel."

The Western Society of Engineers' noon-day luncheon meetings have been resumed. The following speakers have been announced: Nov. 12, E. J. Mehren, editor, *Engineering News-Record* on "An Engineer's Observations in Europe." Dec. 11, Dr. George E. Vincent, president of the Rockefeller Foundation.

The Western Society of Engineers' technical meetings for November include the following addresses: Nov. 8, Charles Evan Fowler, consulting engineer, N. Y., on "The Evolution of Bridge Design;" Nov. 10, S. W. Parr, professor of applied chemistry, University of Illinois on "Fuels of the Future." The Young Mens' Forum is sponsor for three meetings to be held soon. W. H. Fogerty of the Alexander Hamilton Institute will speak Nov. 13, Saturday afternoon, on "Mental Training;" G. R. McDermott, mechanical engineer, Illinois Steel Co. and F. H. Wilcox, mechanical engineer, Freyer-Brassert Co., Nov. 15 on "Waste Heat Utilization," and C. W. Gennet, Jr., engineer, Robert W. Hunt Co., Nov. 18, on "Steel Rails."

PERSONAL NOTES

W. H. FRANKLIN, for four years manager of the James Black Masonry and Contracting Company, Chicago, has entered the employ of the Morava Construction Company, Chicago.

C. H. BIRDSEYE, chief geographer of the U. S. Geological Survey, completed arrangements with the district engineer of the Corps of Engineers at Chattanooga for co-operative work between the Geological Survey and the Corps of Engineers on the survey which is to be made of the Tennessee River basin.

IRA ROGERS, recently identified with road projects in Lynn County, Kan., has been appointed resident engineer on Federal Aid Project 60, Kansas Highway Commission, with headquarters at Garnett.

PAGE GOLSAN, formerly assistant-to-the-president Great Western Power Company, consulting engineer for the Fleishhacker interests and of the Western office of C. B. Peters Co., Inc., exporters, has resigned these positions to be with the firm of Ford, Bacon & Davis, engineers, New York City.

G. R. KENNY, until recently statistician and valuation engineer for the San Joaquin Light & Power Corporation, is now with Ford, Bacon & Davis in valuation, report and special investigation work. Prior to his connection with the San Joaquin Light & Power Co. he was assistant engineer for the Railroad Commission of California.

COLONEL H. W. HUDSON, formerly engineer of construction, Transportation Deaprtment, A. E. F., has been appointed chief engineer of the Interstate Railroad Co., with headquarters at Norton, Va.

CHARLES W. SHERMAN of Metcalf & Eddy, Boston, Mass., has been nominated for the presidency of the New England Water Works Association for 1921.

H. WILSON, engineer maintenance of way of the eastern division, Chicago Great Western R.R., with headquarters at Chicago, has resigned to become trainmaster, Denver & Rio Grande R.R., Denver, Col.

OBITUARY

A. S. MARKLEY, for some time superintendent of bridges and buildings, Chicago & Eastern Illinois R.R., died Oct. 14 at Danville, Ill.

JAMES H. SHERMAN, president of the Sherman Engineering Co., Kansas City, Mo., died in that city, Oct. 2. He was 36 years old. Previous to opening his office in Kansas City he was in the Engineer Corps of the army and had been connected with the Truscon Steel Co., Lehrack Engineering and Contracting Co., and Burrell Engineering Co. at Oklahoma City.

GEORGE M. INGRAM, vice-president Warren Brothers Co., Boston, Mass, died Oct. 28 at Nashville, Tenn. Prior to his association with Warren Brothers Co., which began in 1902, he had organized the Nashville Roofing & Paving Company.

LOUIS B. JONES, on the engineering staff of the Maine Highway Commission, was the victim of an elevator accident which caused his death on Oct. 12 at Portsmouth, N. H., where he was attending a conference on the new interstate bridge. Mr. Jones was 48 years old and a graduate of the United States Naval Academy, class of 1894.

WILLIAM MARRIGAN, contractor, died Oct. 18 at Port Arthur, Canada. He was born in Beauce County, Quebec, 1861, and had been in the contracting business since 1883. Since that time he had been engaged in the following works: Ballasting operations on sections of the Bangor Aroostook Ry. in Maine and the construction of railways, bridges and canals in Canada.

PHILIP A. MORLEY PARKER, one of the leading engineers in the Federated Malay States, died at Kuala Lumpur Aug. 4. For several years he was in the service of the Punjab Irrigation Depot. He then entered private practice in London and later went to Australia in charge of the Sydney underground railway. About two and a half years ago he went to Malaya and, until his death, was connected with J. A. Russell & Co., Kuala Lumpur. He specialized in hydraulic engineering and was the author of the book "The Control of Water."

MICHAEL H. FOLEY, pioneer lumberman and railroad contractor, of St. Paul, Minn., died in Los Angeles, Cal., Oct. 20. He was born in Lanmark County, Ontario, Canada, in 1845. He went to Minnesota in 1879 and, with his two brothers, established the firm of Foley Brothers. His firm was largely interested in building nearly all the railroad systems of the Northwest. The ocean terminal at Halifax is one of the more recent projects of the firm.

BUSINESS NOTES

W. L. SAUNDERS, formerly in the engineering department, Concrete Steel Co., New York, has been transferred to the Washington office as district engineer.

THE AMERICAN ENGINEERING CO., Philadelphia, has opened a new office in Cincinnati for the purpose of extending Taylor stoker representation and service. M. M. Masson is in charge of this office.

J. J. ARNSFIELD, formerly advertising manager of Fairbanks, Morse & Co., has been elected president of the Engineering Advertisers' Association of Chicago to succeed A. H. Hopkins, resigned.

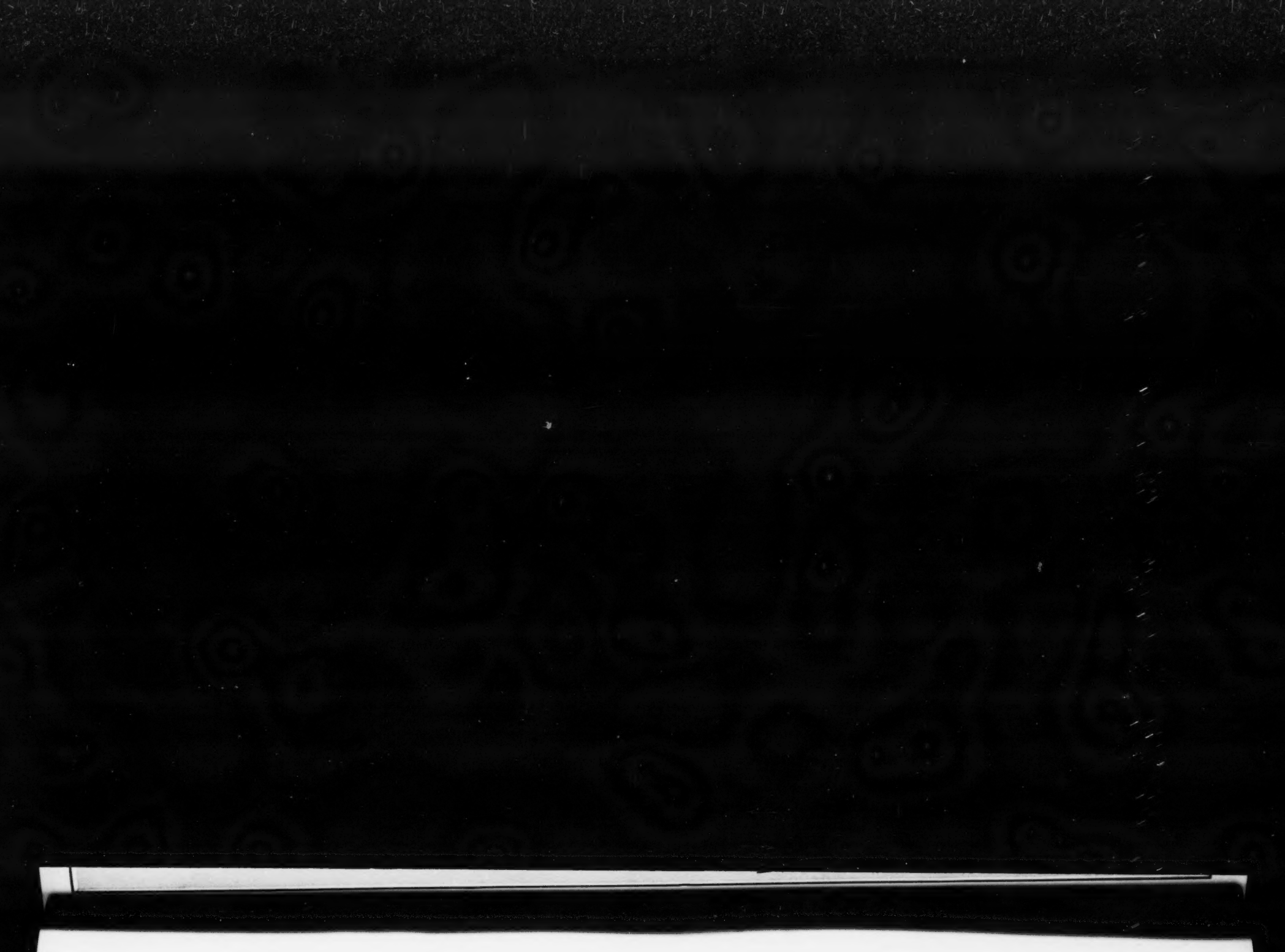
FREYN, BRASSERT & CO., engineers, Chicago, have been appointed consulting engineers for the Royal Netherlands Blast Furnace and Steel Works Company, The Hague, Holland.

W. J. CLUFF of Toronto has been nominated director of the King Edward Construction Co., Toronto.

JANS & DREW COMPANY, engineers and contractors, representing the Hydraulic Steel Craft Company, Cleveland, have opened offices at 1806 Main St., Dallas, Tex. They will specialize in the construction of hydraulic steel factory and warehouse buildings.

C. W. HUNT ENGINEERING CORPORATION has been organized in the interests of the Hunt products and all engineering services previously performed by the C. W. Hunt Co., Inc., New York.

THE HUNTER MACHINERY Co., Milwaukee, Wis., formerly Kern-Hunter Co., announces a service department under the charge of G. N. Spiess, formerly with George F. Smith Co., St. Louis.

THE AMERICAN WOOD PIPE CO., Tacoma, Wash., announces the appointment of Anton J. Berger as district manager of its recently established Chicago office in the Marquette Building.

G. SCHIRMER has resigned as sales engineer Whiting Foundry Equipment Co. to become associated with W. C. Bennett, industrial engineer, Chicago, engaging in all branches of foundry and industrial engineering, designing, superintending and equipping of complete installations.